JULY 1938

WIRE AND WIRE PRODUCTS

HERE'S A PRACTICAL SUGGESTION FOR PROGRESSIVE WIRE MILL EXECUTIVES

With the steel industry as a whole considerably below normal; with your primary markets for wire and wire products at an extremely low level,—isn't it a mighty opportune time—RIGHT NOW, —to take a good look at *your* equipment, —with an eye to the future? Tomorrow's changing consumer demands, new materials, new competition will demand machinery that possesses higher speed, increased flexibility, and greater adaptability for *any* job. Vaughn has been planning, designing and building with these basic ideas in mind. One of our engineers will be glad to discuss your modernizing or realignment problems—any time—anywhere!

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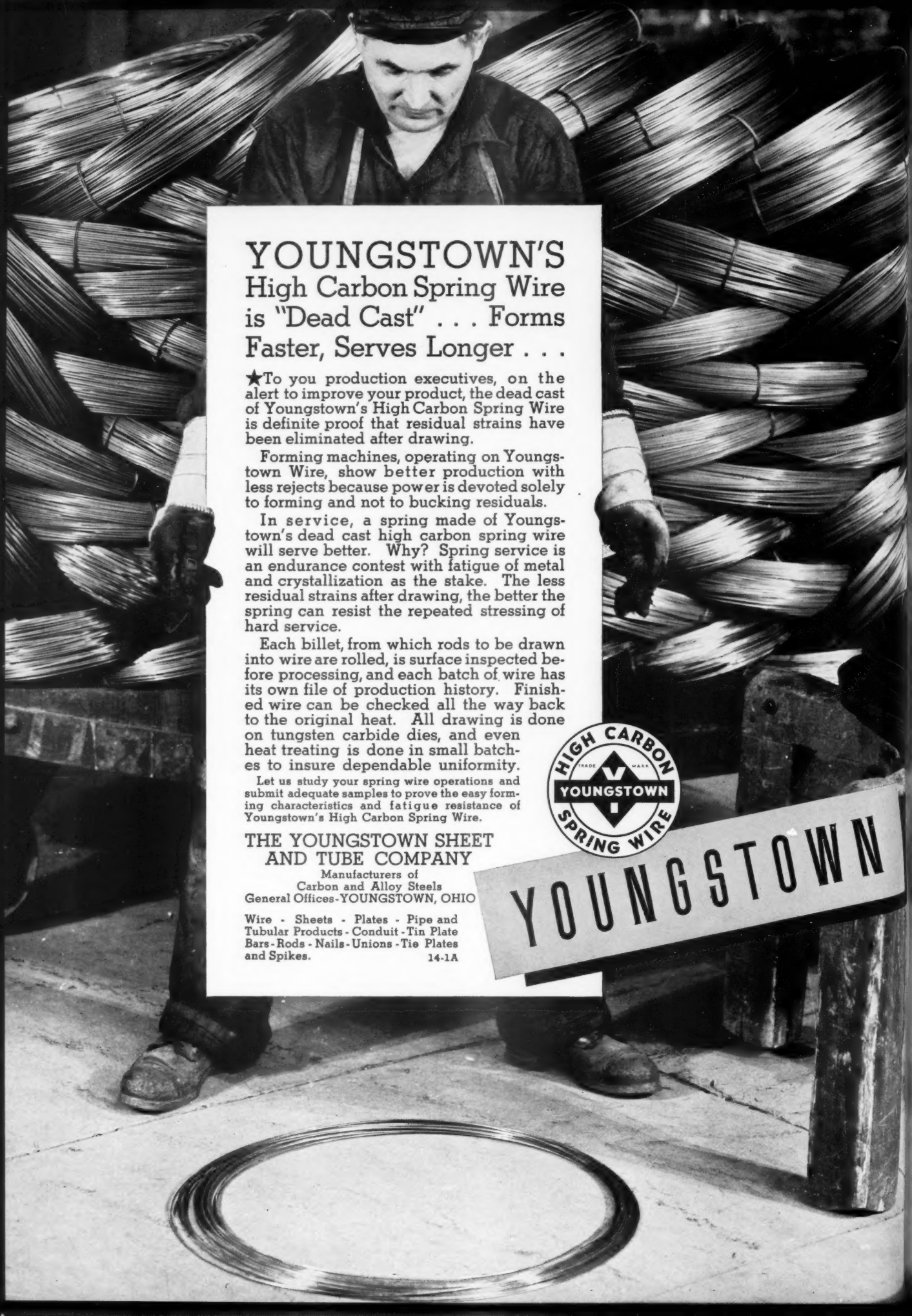
CUYAHOGA FALLS, OHIO

VAUGHN
WIRE DRAWING EQUIPMENT

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION



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High Carbon Spring Wire is "Dead Cast" . . . Forms Faster, Serves Longer . . .

★To you production executives, on the alert to improve your product, the dead cast of Youngstown's High Carbon Spring Wire is definite proof that residual strains have been eliminated after drawing.

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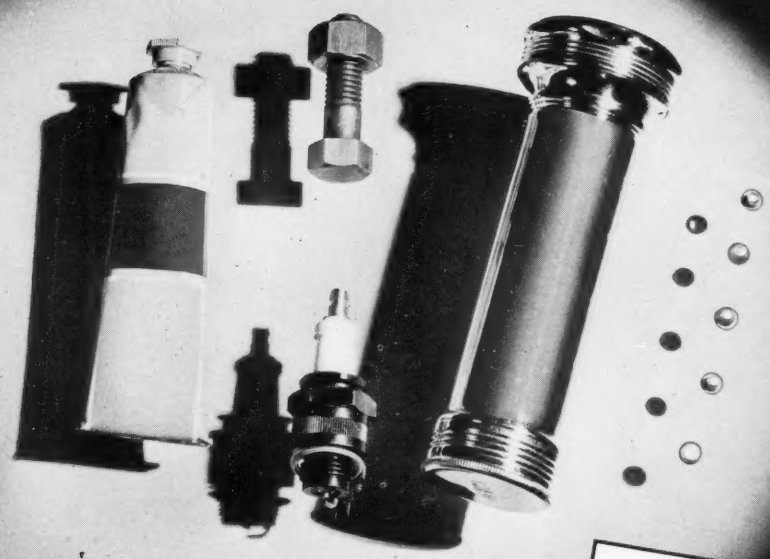
Strange companions...

...with but one thing in common!



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Bolts: Rolled thread section sized for more uniform thread diameter.

Nuts: Burnished with controlled corners.

Spark Plugs: Body machined from hex stock drawn through Carboloy dies.

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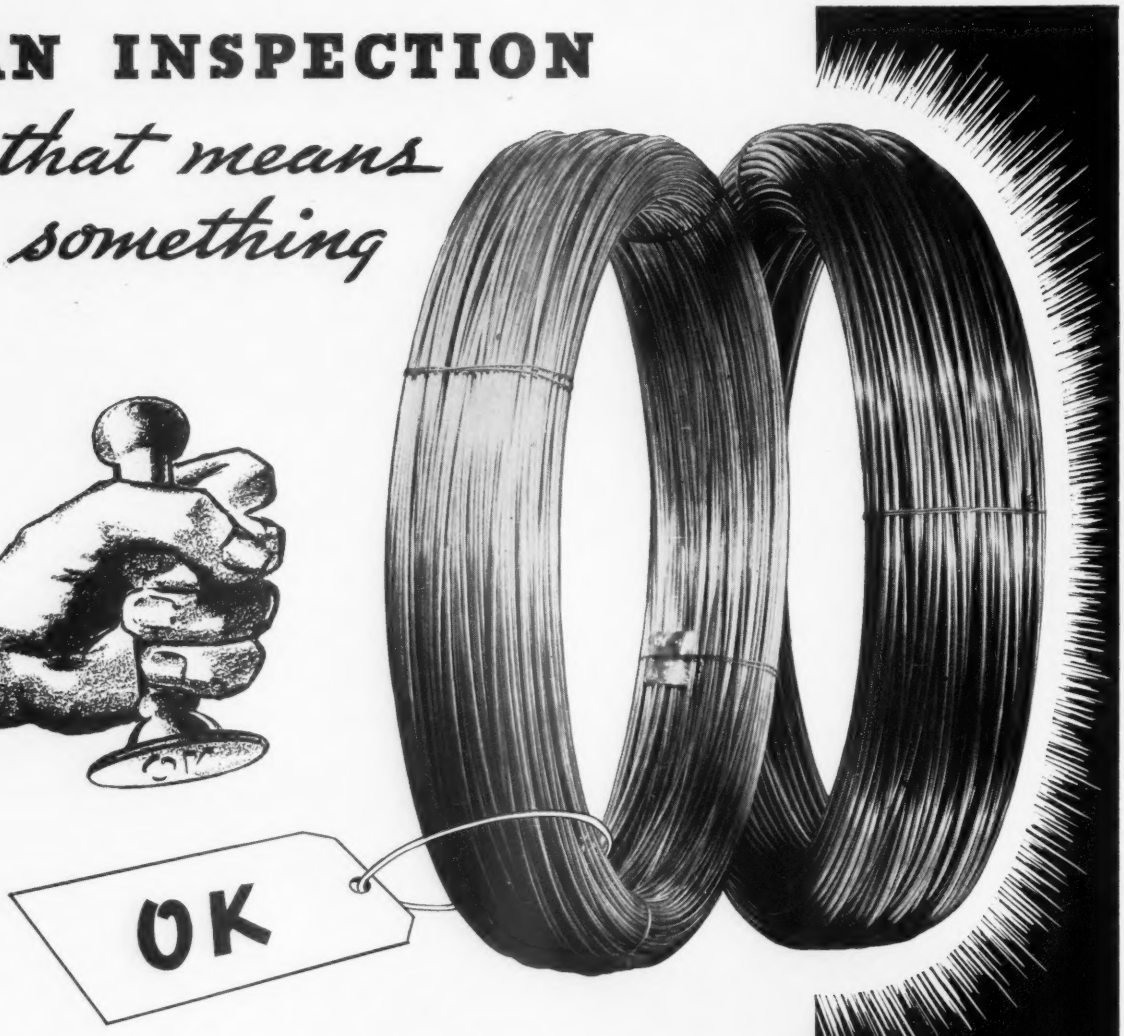
The Mark of CARBOLOY

WIRE & WIRE PRODUCTS, Vol. 13, No. 7, July, 1938, Executive office, 17 East 42nd St., New York, N. Y. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.

AN INSPECTION

that means something



A "Pittsburgh Steel" inspection is no perfunctory affair. Realizing that the finest machinery built, manned by the most conscientious and skilful workmen, does not always function perfectly, we take nothing for granted. Frequent precision tests are made at every stage of the production of your particular type of wire. The result is you can always depend upon your supply of "Pittsburgh" Wire to be uniformly graded to fit your specifications and to meet the fabricating requirements in your plant. Further, if you need help in arriving at the exact kind of wire best suited to your production problem, our engineering staff is at your service to work out the solution. A letter brings full details.

PITTSBURGH STEEL CO., 1690 GRANT BLDG., PITTSBURGH, PA.

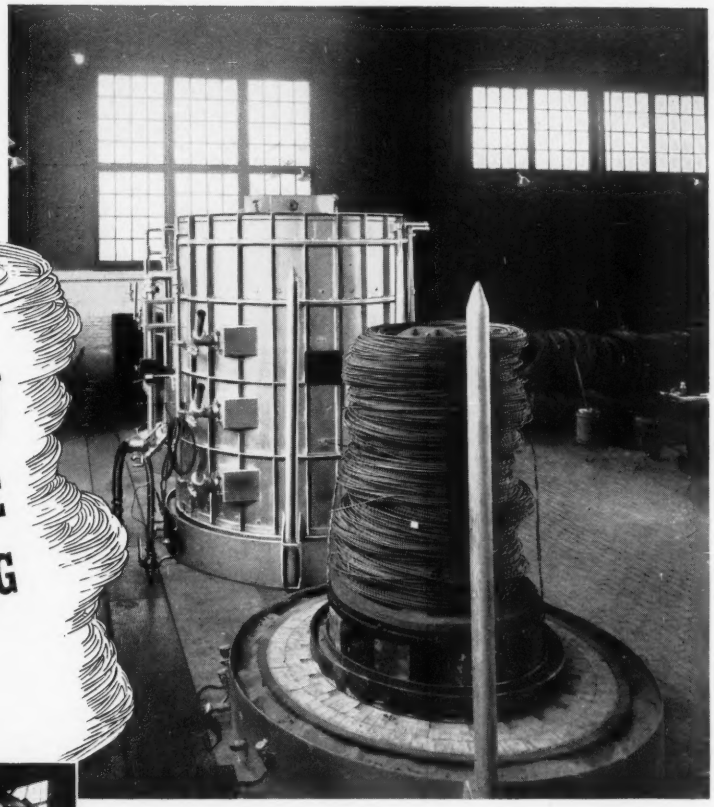
NEW YORK DETROIT CHICAGO CLEVELAND
MEMPHIS HOUSTON LOS ANGELES

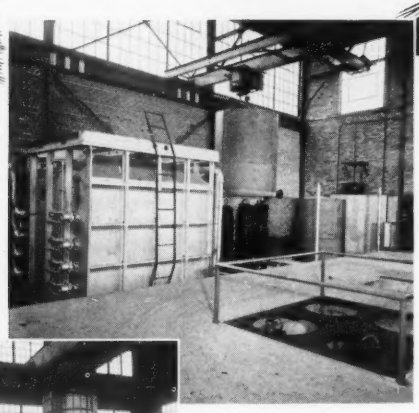
Spring Wire • Chain Wire
Box Binding Wire • Lavite
Annealed Wire • Welding
Wire • Core Wire • Cold
Heading Wire • Bail Wire
Spoke Wire • Rivet Wire
Chaplet Wire • Link Wire
Nail Wire • Crimping Wire
Cap Screw Wire • Stapling
Wire • Bolt Wire • Tack
Wire • Spark Plug Wire

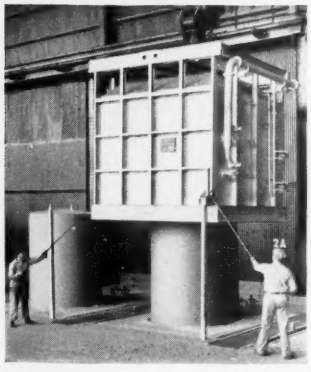
Pittsburgh Wires

FOR EVERY PURPOSE

HERE'S HOW YOU CAN REDUCE YOUR ANNEALING COSTS!







Shown are four recent installations of SC Radiant Tube Bell-Type Covers for spheroidizing, annealing, and normalizing wire. Covers are in operation treating single, to as many as four stacks of coils at the same time.

STOP heating excessive tare weight in the form of heavy pots and containers—and you will reduce your heating time, fuel consumption, and maintenance. Eliminate or reduce scaling and decarburization—and you will eliminate or reduce pickling. Combine these savings and you will be astonished at the reduction in your annealing costs.

How can you do this? Install a modern SC Radiant Tube Annealing Cover for annealing, spheroidizing, and normalizing your wire or rod, and you will have accomplished every result referred to above.

On a recent typical installation the average fuel consumption of 250 heats was 825 Btu per net pound (less than one cubic foot of natural gas). Other actual operating data shows 6,000 pounds of wire heated to 1340°F. in 2¾ hours.

A leading metallurgist in the plant of a prominent bolt manufacturer recently stated that even without the use of DX atmosphere in this type of furnace, they were spheroidizing SAE 3135 and 1335 rod without scale and decarburization.

Ask for complete information. Arrangements can be made for you to see a unit in operation.

SURFACE COMBUSTION CORPORATION • TOLEDO, OHIO

SURFACE COMBUSTION

Builders of ATMOSPHERE FURNACES and HARDENING, DRAWING, NORMALIZING, ANNEALING FURNACES for CONTINUOUS or BATCH OPERATIONS

For Forming Special Shaped Wire!
For Embossing Wire!
Use A "TURKS HEAD"

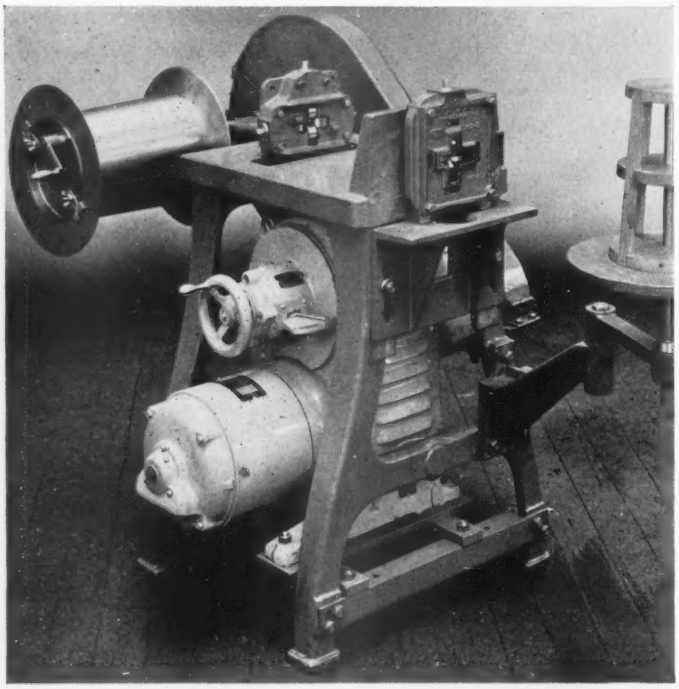
▲▲▲

It combines the functions of a wire drawing machine for pulling and for bundling the wire, but instead of the conventional type dies through which the wire is usually drawn, utilizes a system of rolls.

"TURKS Heads" are of two types — The Universal Type and The Plain Type. ✦ ✦ ✦

THE Universal Type is used to convert round wire to rectangular sections. ✦ ✦ ✦ ✦

THIS type has flat faced rolls only. ✦ ✦ ✦ ✦



THE Plain Type is used for forming special shapes of wire and also for embossing designs on Wire. ✦

THIS type may have rolls formed for special shapes or rolls with designs engraved on them. ✦ ✦ ✦

The machine illustrated shows two "Turks Heads" mounted in tandem - - In operation the wire is taken from the pay-off reel, converted to a rectangular shape in the universal head and then embossed with a design or shaped further in the plain type head. Following that the wire is coiled on the drum shown at the left.

We Would Be Glad To Discuss Any Special Requirements With You.

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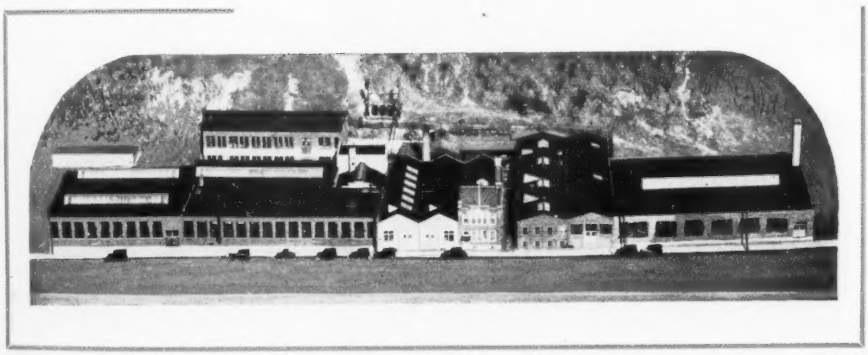
Leak-proof Enameled Wire

It is the copper we use that enables us to state without qualification that Winco Enameled Wire will not leak. We use special oxygen-free copper that draws so clean, so free from slivers, that the enameling is perfect. There's not a leak in it. Every foot of wire is mercury-tested before shipment to assure the buyer a wire as perfect as humans can make it. Write for a generous sample.

* * *

Winco Enameled wire is covered to the same dimensions as fabric-covered wire so the user need not change his equipment. It will withstand softening in varnish-dipping and baking. It costs considerably less than silk-covered wire. Write for sample.



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Hudco Products cover a complete line of fine wires of all kinds, bare and for metal spraying. Also, brush wires of all kinds, tinsel lahns, metallic fibres for packing purposes, etc. Hudco is headquarters for supplies of this sort. Established in 1902, experience and skilled workmanship are back of every Hudco product.

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ESTAB. 1902 Successors ROYLE & AKIN ESTAB. 1902

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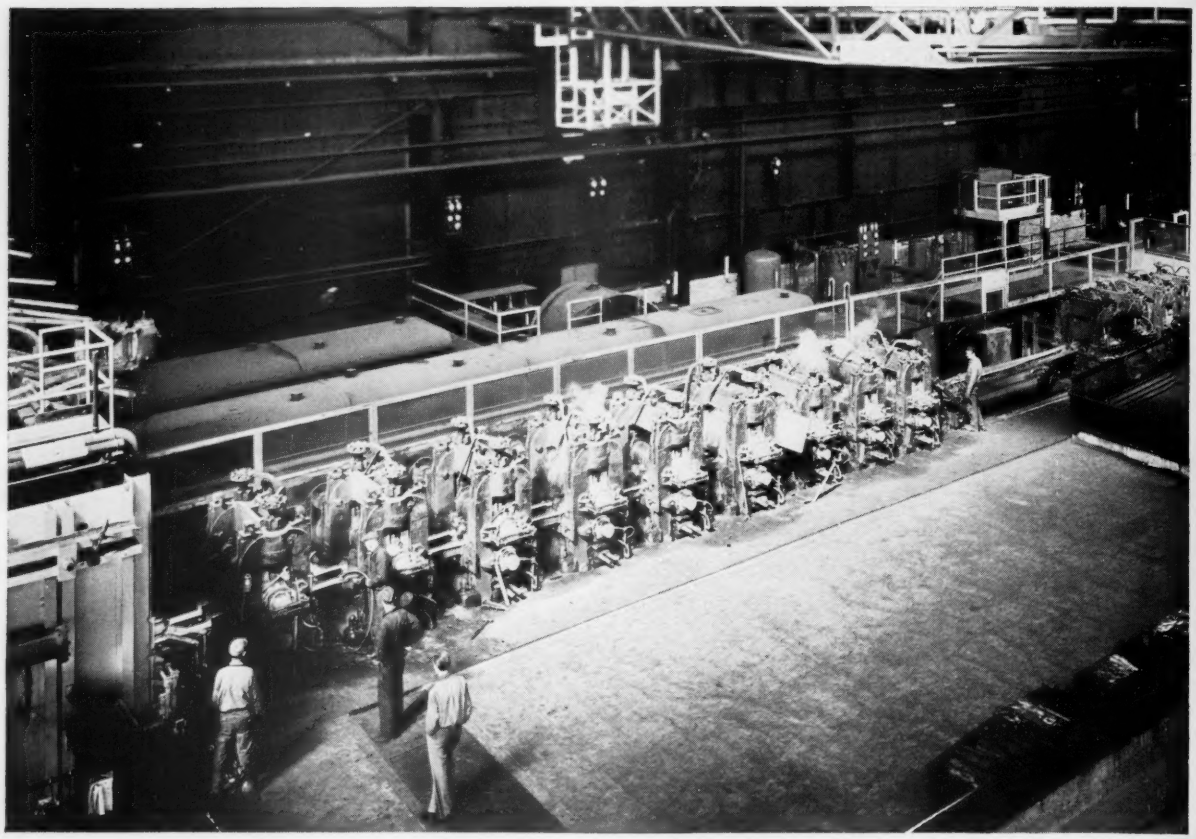


enhance
BETHLEHEM SERVICE to Rod Users

THE new rod-manufacturing facilities, now in operation at Bethlehem's Maryland Plant, substantially broaden this company's service to manufacturers of wire and wire products. The new rod mill, representing the latest development in equipment for rod production, in addition to other facilities, assures highly efficient service on either large or small tonnages in a wide range of grades, sizes and coil weights.

Bethlehem makes a complete range of rods in three general classifications: basic open hearth and Bessemer in low and medium carbon ranges, and basic and acid open hearth in higher carbon ranges. Rods in all analyses are made within these general classifications, providing material for wire for virtually every purpose.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

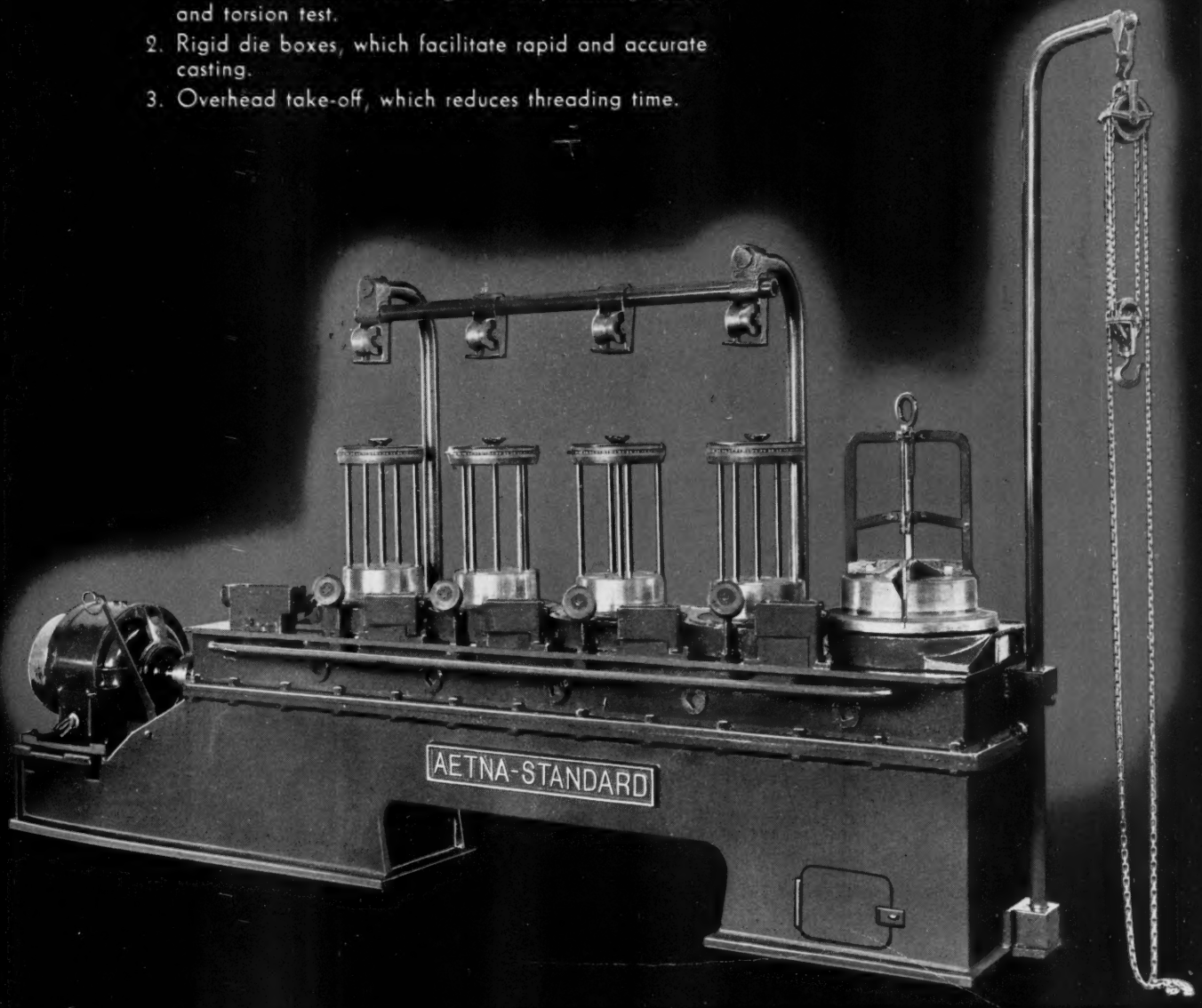
AETNA-STANDARD

Wire Drawing Machine

MAXIMUM EFFICIENCY
MINIMUM UPKEEP

Among important features are:

1. Unusually effective system of water cooling, which has the effect of increasing die life, finishing speed and torsion test.
2. Rigid die boxes, which facilitate rapid and accurate casting.
3. Overhead take-off, which reduces threading time.



THE **AETNA-STANDARD** ENGINEERING COMPANY

CONSULTANTS—DESIGNERS AND BUILDERS TO THE STEEL AND NON-FERROUS INDUSTRIES

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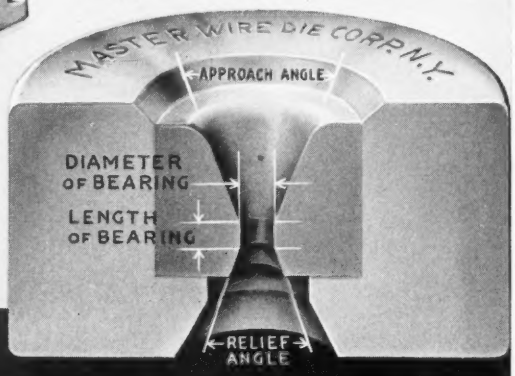
Without such a machine, — conceived, built, and patented by us, — we would not be able to manufacture a semi-finished Carbide Die one step from finishing so inexpensively as to make any other plan of marketing Carbide Dies far too costly for the wire drawer.

SEMI-FINISHED DIE



MASTER WIRE DIE CORPORATION

408 CONCORD AVENUE NEW YORK CITY

ADVANCEMENT PRECISION ACCURACY TRADE MARK

Diamond WIRE DRAWING DIES

Carbide® WIRE, ROD AND TUBE DIES

Steel COLD HEADING AND TRIMMER DIES

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol 13 JULY, 1938 No. 7

Designated as

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A Series of Three Lectures Outlining the Fundamental Principles of Wire Mill Metallurgy Will Be Presented at the 1938 Wire Association Meeting at Detroit

By B. L. McCarthy,
Chief Metallurgist,
Wickwire Spencer Steel Co.,
Buffalo, N. Y.

Tentative titles are:

Part I—Principles of Metallurgy

Part II—Thermal Reactions

Part III—Metallurgy of Steel Wire

THESE lectures will be in simple language, understandable by the non-metallurgist and will be presented as a part of the program of the Wire Association Meeting at Detroit, Michigan, October 17 to 21st inclusive.

MEMBERS of the Wire Association will be entitled to attend these lectures without additional cost other than the regular registration fee for the meeting.

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FIRTHALOY
QUALITY

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The closer tolerances, more rigid specification and increased use of alloy steels have brought tube makers new problems. Steel dies and mandrels fail to meet the new conditions. Many large producers of both steel and non-ferrous tubing who are using dies and mandrels made of Firthaloy are having no difficulty in meeting the present rigid requirements, and at the same time obtain superior finish on both the inside and outside of tubing.

The hard polished surface of Firthaloy mandrels will not pickup or hold slivers that result in the scratching or marring of the finished work. They hold size without cratering over a long period of time giving remarkable "on size" footage, as well as eliminating frequent replacements.

The steadily increasing use of Firthaloy mandrels proves that they are very economical when their ultimate cost is compared with that of other mandrels, and when the long life and better finish are considered.

Firthaloy tube mandrels are available with shanks to fit your holder bars or rods and are furnished in all of the standard and special sizes.

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CLEVELAND DAYTON
GLOBE WIRE DIVISION
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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 13 JULY, 1938 No. 7

Furnaces for Ferrous and Non-Ferrous Wire

By H. M. Heyn,
Sales Manager, Heat Treating Division,
Surface Combustion Corp., Toledo, O.

Recent developments in furnaces for ferrous and non-ferrous wire together with an outline of the advantages of specific types for special purposes.

IT has often been said that it is impossible to stand still. The world is constantly going forward and, therefore, relatively you must go either forward or backward.

✦ ✦ ✦

THIS is a universal law which pertains to individuals and to industry alike. Obviously, it has been well headed by the wire industry for in the past few years many developments have taken place, tending to make possible a better product at a lower cost.

✦ ✦ ✦

IT is the purpose of this paper to briefly describe a few typical and recent furnace developments which have accompanied other developments in the wire industry.

✦ ✦ ✦

Control of Scale and Decarburization

IN the last few years there has been a decided trend in the wire industry to controlled atmosphere furnaces in which the work is heated in the presence of a non-scaling and non-decarburizing atmosphere. In some instances, such as, when treating low carbon wire, the primary function of this type of furnace is to eliminate or at least reduce scaling. In other cases, such as, when treating medium and high carbon wire, the controlled atmosphere furnace must serve a dual purpose. In this case such a furnace must not only eliminate or reduce scaling but it must also prevent decarburization.

H. M. HEYN

Educated in the East, majoring in thermodynamics and works engineering, at the Cooper Union and Pratt Institutes. After a short connection with the chemical industry, he joined the Surface Combustion organization, twenty years ago. During this time he has had an opportunity of being a factor in furnace development from the introduction of the first scientific furnace employing automatic proportioning burning of gas to the present-day furnace utilizing controlled atmospheres. Member Wire Association.

✦ ✦ ✦

A VERY popular batch type furnace designed for the use of controlled atmosphere is shown in Fig. 1. It can be used for annealing, normalizing, and spheroidizing. Heating is accomplished by means of gas fired radiant tube heating elements.

✦ ✦ ✦

IN operation, coils of rod or wire are stacked around a center portable spindle which has a flanged bottom. The loading is usually done with the spindle resting on the building floor. After the spindle is loaded, it is moved on to a permanent base and thermocouples tied to the bottom, center and top of stacked coils. A light steel inner cover is then placed over the stack of coils, the lower edge of the cover resting in a self-centering sand seal. The radiant tube heating cover is then lowered over the entire assembly and also sealed in sand. Fig. 1

shows heating cover #1 ready to lower over load on base #2 and cover #2 in position on base #3 ready for gas, air and electric connections.

✦ ✦ ✦

EVEN though a special atmosphere gas is not used, no complete decarburization occurs. When discussing this installation at the last wire convention in Atlantic City, the metallurgist of the company where these furnaces are installed stated that in the annealing of rod they do not encounter any complete decarburization even on SAE 1035 and 1335 steels. He further stated that the slight amount of decarburization which does occur is only partial and in their experience has never run over two-thousandths. It was said that the annealed rod does not have any more scale than when loaded into the furnace.

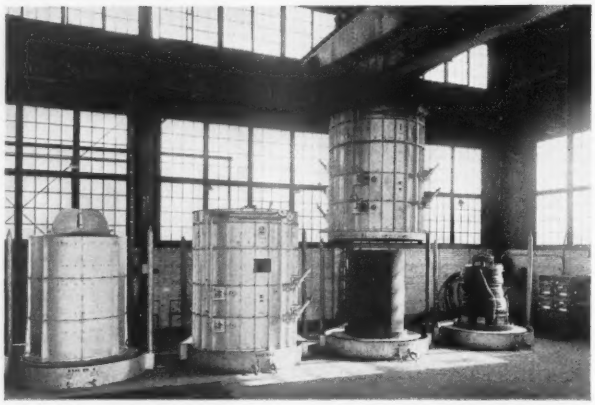

Fig. 1. Two radiant tube bell type covers showing sequence of operations.

✦ ✦ ✦

THESE factors can be attributed to the fact that the products of combustion never come into contact with the work and to the double sand seal which effectively prevents infiltration of air. In this case the slight amount of air entrapped within the inner cover is converted into a non-reactive atmosphere by the use of a wood block placed on the base with the charge. Circulation is maintained within the inner cover by the use of a reversible fan mounted in each base. It has been found by experience that in this type of furnace a more uniform temperature distribution is obtained by circulating the atmosphere within the inner cover as this brings into play the very desirable form of heat transfer known as convection.

✦ ✦ ✦

THE atmosphere in this case is not a special atmosphere but consists of the entrapped air of which the oxygen has been transformed into a non-reactive atmosphere by the burning of a wood block placed on the base with the charge. This installation has been equipped to use a prepared atmosphere of DX gas but it has not been found necessary to do so.

✦ ✦ ✦

WHEN annealing, spheroidizing, or normalizing, after the work has been soaked at the predetermined temperature for the desired time, the heating cover is removed and placed over a stack of coils loaded on another base which has been previously prepared. An insulated cooling cover is then lowered over the inner cover of the heated load. A complete cycle of change takes only from 3 to 5 minutes and hence the heat loss when transferring from one base to another is small.

✦ ✦ ✦

WHEN spheroidizing the charge under the cooling cover is controlled to a drop in temperature of 50° F. per hour. Operating furnace specifications are a minimum of 70% spheroidization and a maximum of 149 Brinell Hardness for SAE 1035 steels. On 1335 and 3135 grades, these specifications are 80% spheroidization and a maximum hardness of 163.

✦ ✦ ✦

THE flexibility of the radiant tube heating cover makes it adaptable to spheroidizing, annealing or normalizing as desired. This particular company is cold-heading most of their bolts and stated that they get the best plasticity and softness essential to economical die life when using a spheroidized structure. Especially is this true, they stated, when using alloy steels. For a more complete description of this installation see the paper entitled "Thermal Treatment of Rods and Bolts" by L. S. Cooch in the December, 1937 issue of "Wire and Wire Products". Also see the discussion of this paper in the proceedings of the 1937 Annual Wire Association Meeting.

✦ ✦ ✦

FIG. 2 shows a multi-stack cover of this same type for annealing wire for stitching, stapling, book-binding, mattress coil, and rivet stock.

✦ ✦ ✦

THIS particular installation was designed to anneal four stacks of coils at a time instead of one as in Fig. 1. The maximum net charge is 13,000 lbs. Since the coils are loaded on the spindles to a height of 72", a loading and unloading pit as shown has been found to be very

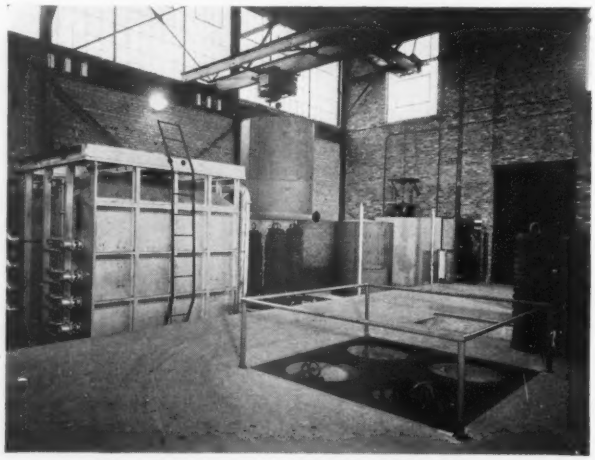

Fig. 2. A radiant tube bell type cover for annealing four stacks of coils at the same time.

✦ ✦ ✦ ✦ ✦

convenient. As in Fig. 1 a circulating fan is used without a prepared atmosphere. One man, unassisted, handles the installation, together with wire into and out of the department.

✦ ✦ ✦

Continuous Atmosphere Furnaces

FOR both hardening and annealing, continuous controlled atmosphere furnaces are finding many applications. When fuel-fired, they may be either of the radiant tube or muffle type. In either type furnace, one of the early mechanical problems that had to be licked was the sealing of the furnace against excessive leakage of the atmosphere and air infiltration through the charge and discharge doors of the furnace. That this problem has been licked is evidenced by the fact that a short time ago we placed in operation a continuous radiant tube controlled atmosphere furnace for annealing bath tubs having dimensions 62″ x 82″ and conveyed through the furnace in an upright position.

✦ ✦ ✦

FIG. 3 shows an atmosphere furnace for clean hardening steel springs of miscellaneous sizes and types. It is a muffle type furnace over and under fired by means of low pressure velocity burners. The atmosphere gas is prepared in a separate DX unit and is introduced continuously into the muffle. The springs are quenched automatically and are conveyed from the quench tank by means of a conveyor as shown.

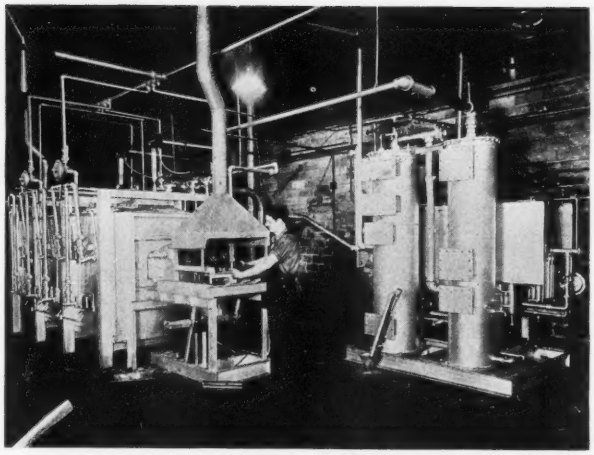

Fig. 3. Charge end of muffle type furnace for clean hardening springs.

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THE springs as they come from the quench tank are clean and free of scale and decarburization.

✦ ✦ ✦

FIG. 4 shows a continuous pusher type atmosphere furnace for annealing copper on spools. The spools are 3″ high and have a maximum diameter of 16″ and a minimum diameter of 4″. In addition to spools, this furnace is also being used to anneal rod in bundles. The work is loaded on trays and is pushed through the furnace on tracks. The last section of the cooling zone is provided with rollers to facilitate removing the trays.

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HEATING is accomplished by means of gas-fired radiant tubes. A DX atmosphere is maintained in both the heating and cooling zone.

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FIG. 5 shows another continuous bright annealing furnace for large copper reels. This is a muffle type furnace and as may be noted in the illustration is equipped with an inclined atmosphere seal. The reels annealed in this furnace range in size from 16″ O.D., by 12″ wide to a maximum of 28″ O.D. by 12″ wide, weighing 250 and 1000 lbs. respectively.

✦ ✦ ✦

THE reels are conveyed through the furnace on cross rods mounted on two chains which in turn ride on guides projecting from the side of the muffle. The reels are placed on the cross rods through the core. Since the distance from the chains to the bottom of the muffle is less than the radiums of the reels, the latter rotate while being conveyed through the furnace, thus assuring uniformity in the temperature of the work.

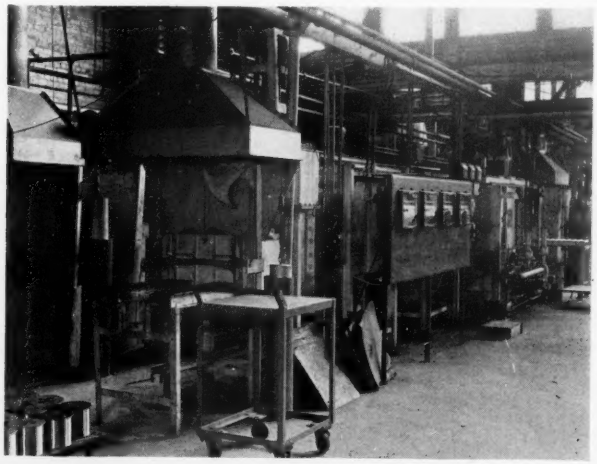

Fig. 4. Continuous radiant tube controlled atmosphere furnace for bright annealing copper.

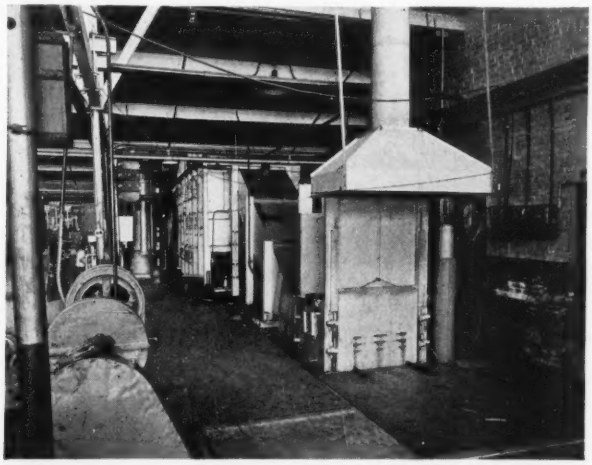

Fig. 5. Continuous muffle type controlled atmosphere furnace for large copper reels.

DX Atmosphere

BOTH of the above installations utilize an atmosphere of DX gas. The work upon emerging from the furnace has a bright shiny luster and no pickling is required.

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AN interesting side light developed in connection with the bright annealing in these furnaces. The continuous tinning equipment on certain sizes of wire was being carried on in the same building as the annealing operations. The vapor of hydrochloric acid used in this operation caused a brown stain on any work which was left standing in the building for more than one day. This stain could not be removed in the annealing operation. The tinning equipment was moved to another building and the stain no longer appeared.

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THE DX gas being used in these two furnaces has the following approximate analysis:

CO_2	9.4%
O_2	0.0%
CO	1.5%

✦ ✦ ✦

IT will be noted that the above analysis is almost that of a perfect air-gas ratio.

✦ ✦ ✦

THIS brings up another point. It is quite commonly known that by controlling the products of combustion in a direct fired furnace, it is possible to bright anneal copper. Of late, the interpretation being placed on a controlled atmosphere furnace is one using a special atmosphere prepared in an extraneous unit. However, the general definition of a controlled atmosphere furnace is one in which work to be heated and cooled is at all times surrounded by a gas of constant composition. If the nature of the work is such that its surface will remain bright when heated in an atmosphere of undiluted products of combustion of uniform composition, an open or direct fired furnace will meet every requirement of a controlled atmosphere furnace. This is true in the case of copper. We recently installed two large continuous furnaces for bright annealing copper tubing which operate on this principle.

✦ ✦ ✦

Units for Producing DX Gas

PERHAPS one of the chief reasons for today's popularity of the controlled atmosphere furnace using a prepared atmosphere is the perfection of present day units for producing the atmosphere simply and inexpensively. A typical unit having a capacity of 1500 c.f.h. is shown in Fig. 6.

✦ ✦ ✦

IN the preparation of DX gas, natural gas or any of the manufactured gases may be used as the base gas. A wide variety of air-gas ratios can be used varying from a mixture slightly below the exothermic point to a practically neutral oxygen free gas. However, the most commonly used ratio is six parts of air with one part of natural gas or the equivalent in other gases.

✦ ✦ ✦

THE equipment for generating this gas consists of an insulated horizontal cylindrical combustion chamber equipped with a proportioning type burner. The flue gases are passed through a water cooling tower in which they are washed and dropped to approximately tap water temperature. From here they are conducted to a cooling machine which decreases the moisture content to any desirable dew point down to approximately 38° F. The cost of preparing this gas is only 1/6 to 1/3 the price of the raw fuel gas. With natural gas at 40 cents per 1000 cubic feet, DX gas may be prepared for approximately 7 cents per 1000 cubic feet.

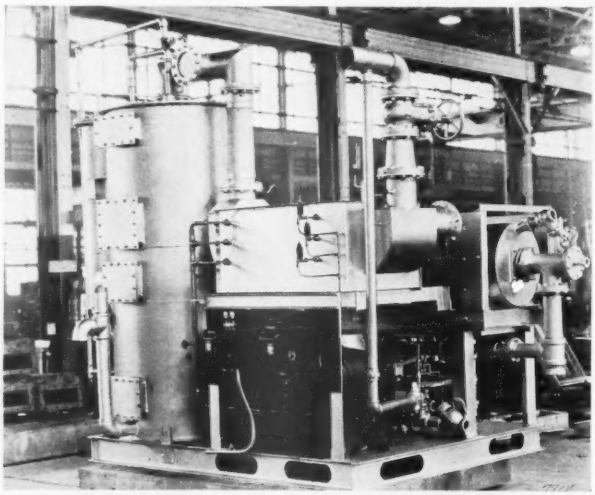

Fig. 6. DX atmosphere gas preparation unit with capacity of 1500 C.F.H.

✦ ✦ ✦

Convection Furnaces

IN the conventional type furnace using a multiplicity of burners, the chief source of heat transfer is by radiation. The lining becomes hot and the work is heated much as the earth is heated by the sun. The electric furnace is also a good example of radiant heat.

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IN any fuel fired furnace where products of combustion exist, there enters another form of heat transfer known as convection. Convection is a form of heat transfer due to the motion of warm fluids such as gases or liquids. When the circulation occurs naturally due to temperature change, it is known as natural convection. One of the most common examples of this is the old hot air furnace. When the circulation is artificially promoted, as by the use of a fan, it is known as forced convection.

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CONVECTION heating possesses many desirable characteristics, among which is the uniform heating resulting from the intimate contact of the hot gases with the work being heated. In the so-called convection type furnace, advantage is taken of this by forced circulation of the products of combustion. In most instances heat is supplied by a

single specially designed air heater usually located on top of the furnace. The products of combustion from this heater are forced into the furnace under slight pressure by a suitable fan. In the furnace the products are uniformly distributed by suitable duct work and dampers. After giving up part of their heat, the hot gases are conducted back to the air heater on top of the furnace and reheated. As much as 80% of the hot gases are recirculated.

✦ ✦ ✦

IN the ordinary fuel fired furnace after the products of combustion have given up a portion of their sensible heat, they are allowed to escape out the flue or stacks to make room for hotter gases from the burners. When burning manufactured gas of 580 Btu in a furnace at 1400° F., the maximum number of Btu's available for heating the work and the furnace is only 366 or 63%. The remainder go out the flues. In a convection type furnace employing 80% recirculation, 464 Btu's are available, equivalent to 80%.

✦ ✦ ✦

ANOTHER reason for the increasing popularity of this type of furnace is its simplicity. Instead of the usual multiplicity of burners usually mounted through the side walls of the furnace, the convection type furnace usually has only one burner which simplifies operation and reduces maintenance.

✦ ✦ ✦

FURNACES of this type are in operation at temperatures as high as 1350° F. One of the most common uses of the convection furnace is for drawing hardened parts. Fig. 7 shows a continuous furnace of this type for drawing coil springs.

✦ ✦ ✦

Direct Fired Furnaces

WHILE controlled atmosphere furnaces are receiving considerable publicity today, the erroneous impression must not be gained that developments have not taken place in the conventional direct fired furnace. In the direct fired normalizing furnace, for instance, considerable work has been done on controlling the grain growth. In the old type normalizing furnace the wire was brought to temperature and in some instances, soaked for a while and then quenched immediately in air or a lead bath.

✦ ✦ ✦

THE new type normalizing furnace is provided with a regulated cooling chamber by which control may be had over the grain size. Such a furnace is shown in Fig. 8.

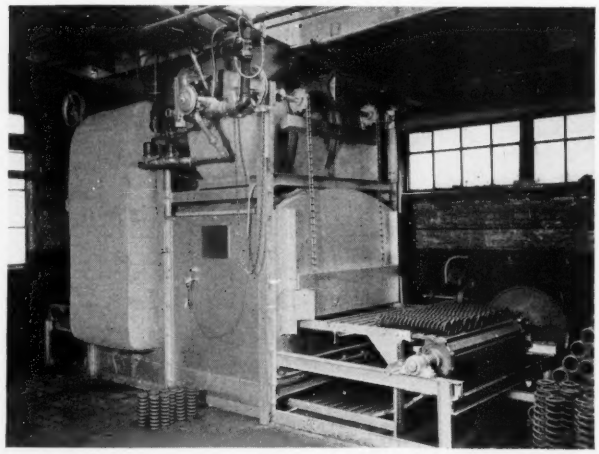

Fig. 7. Convection type furnace for drawing coil springs. ✦

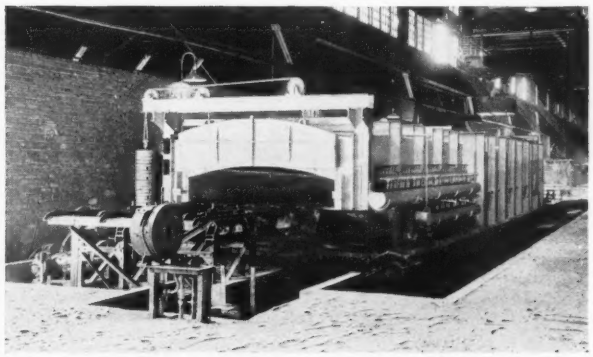

Fig. 8. Continuous normalizing furnace with special cooling chamber for wire. ✦ ✦ ✦ ✦ ✦ ✦

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Vol. 13 JULY, 1938 No. 7

Factors Affecting Grain Growth In Annealed Rivets

PART I

By R. W. Sandelin,

Metallurgist, Atlantic Steel Company, Atlanta, Georgia.

The objectives sought for in the annealing of low carbon rivets are varied but usually include the relieving of strain in the upset areas, the manufacture of a product having consistently uniform physical properties, or the softening of a rivet as a whole so that it may be more easily worked. Generally speaking, a rivet must be soft enough to upset easily and yet produce a union of sufficient strength. In any event, it is of interest to study the resulting structures and observe in what manner and to what degree these structures are affected by various modes of heating for annealing. Published in three parts. ✦ ✦ ✦ ✦ ✦

AT the outset it may be said that one of the incidents prompting this investigation was the observance of an abrupt change in grain structure at a point directly under the heads of certain low carbon rivets which had been subjected to prolonged heating at a temperature of 1350 degrees F. It was further noted that these rivets sheared at relatively lighter loads than other rivets and that the appearance of the fractures or sheared surfaces indicated a lack of toughness or ductility.

✦ ✦ ✦

METALLOGRAPHIC examination of the rivet to ascertain a possible cause for this abnormal behavior revealed the existence of a very coarse ferrite grain structure at the point of fracture. Figures 1 through 4 show the grain structure existing at various points in the rivet. It is quite obvious that the tremendous difference in grain size existing in such a rivet is not a normal condition and was responsible partly for the weakness and ultimate failure.

✦ ✦ ✦

HERE we have another interesting occurrence of grain coarsening associated with the familiar **Stead's** brittleness resulting from critically strained ferrite heated close to but below the lower critical temperature. In this case the zone of critical strain occurred directly below the head at the junction of the shank and head, and resulted in the formation of very large grains. The more severely upset head of the rivet was strained beyond the critical value and in such a condition was not susceptible to exaggerated grain growth.

✦ ✦ ✦

R. W. SANDELIN

Graduated from the University of Minnesota 1931; instructor in Metallurgy at the Georgia School of Technology 1931-1934; Metallurgist for the Atlantic Steel Company, Atlanta, Georgia, 1934 to date. Member of The Wire Association.

Factors Affecting Grain Growth During Annealing

TEMPERATURE, time and degree of previous cold work are perhaps the three most important factors which singly or collectively affect grain growth. Considering each factor separately, it may be stated that, in general, the higher the annealing temperature the greater will be the resulting grain size. However, there are certain exceptions to this general statement notably in the case of low temperature or sub-critical annealing of critically strained low carbon steel, in which case the maximum grain growth is attained at relatively low temperatures, and heating at temperatures several hundred degrees higher actually results in a grain refinement.

[1]**The figures appearing in parentheses refer to the bibliography appended to this paper.**

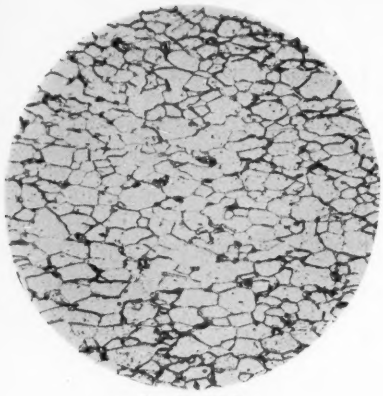


Fig. 1—150-X

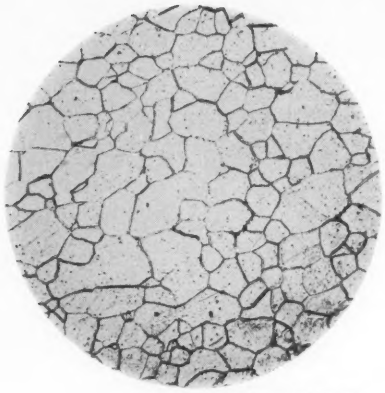


Figure 2 - 150-X

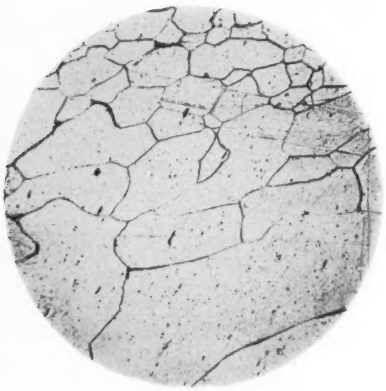


Fig. 3—150-X

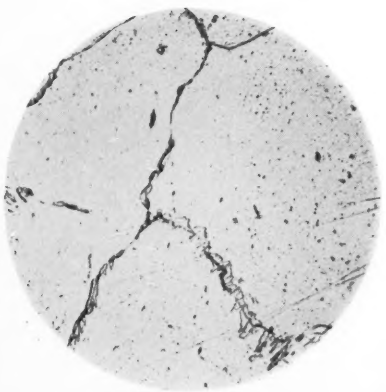
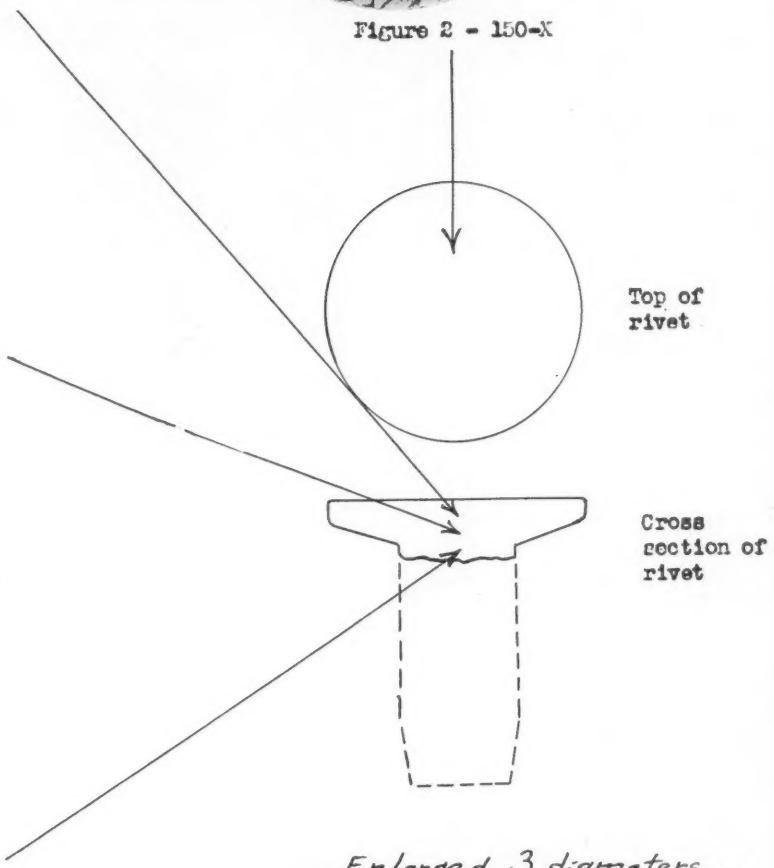


Fig. 4—150-X



Enlarged 3 diameters

TIME of heating is ordinarily an important factor and in general the longer the time interval, the larger will be the resulting grain size, assuming of course that the temperature is above the minimum recrystallization temperature. The minimum recrystallization temperature, however, depends upon the length of time for heating and also the amount of previous cold deformation. In the case of certain types of rivets where a homogeneous condition as to original grain size and amount of cold work does not exist, it can be seen that the recrystallization temperature varies within the self same rivet.

✦ ✦ ✦

THE degree of previous cold work profoundly affects grain growth particularly where relatively low annealing temperatures are used. **Stead's** brittleness, as it is commonly known, results from critically straining low carbon steel slightly above the yield point followed by heating for several hours at temperatures below the critical range, in the region of 1200 degrees F. to 1350 degrees F. which produces an extreme coarsening of grain. Such a coarse grain structure materially lowers the ductility of the steel. This phenomenon which is confined to steels con-

taining less than 0.15 percent carbon has been studied by many investigators and includes **Stead (1)**[1], **Sauveur (2)**, **Jefferies and Archer (3)**, **Kelly and Winlock (4)** and others.

✦ ✦ ✦

REFERRING particularly to wire, **Adam (5)** has indicated that critical strain results in drawing between 8 and 12 percent reduction; **Lewis (6)** has stated that wire should be drawn with a reduction of at least 20 percent to avoid the production of critically strained metal which would make it susceptible to exaggerated crystalline growth on subsequent annealing at sub-critical temperature ranges.

✦ ✦ ✦

WHILE not within the scope of this paper, it might be mentioned in passing, that in the high carbon ranges, the **McQuaid-Ehn** grain size characteristics would affect the resulting grain size. **Brophy and Wyman (7)** observed differences in the annealing characteristics in normal and abnormal steels of fairly high carbon content, namely .71 to .73 percent. It was found that the resulting Rockwell B hardness numbers for all of the variously reduced cold rolled, annealed, abnormal steel samples were approximately the same and occurred within relatively narrow annealing temperatures in the region of 1370 degrees F. On the other hand, the normal steel samples showed considerably higher final hardnesses which were spread over a considerable range of temperature and were notably dependent upon the degree of cold work.

✦ ✦ ✦

CONCERNING the effect of **McQuaid-Ehn** grain size, it has been found that of two samples of steel, one coarse grained and the other fine grained, the fine grained steel resists grain growth at temperatures where the coarse grain steel showed considerable grain coarsening. In other words, the inherent fine grain characteristics exert an inhibiting effect on grain growth.

✦ ✦ ✦

A. L. **Spencer (8)**, in studying the effect of temperature on hot driven rivets, observed that certain highly heated rivets produced subsequent fractures, sometimes directly under the head but more often at some more remote point, which showed little or no reduction in area, indicating a lack of ductility. He found that for each grade of steel there was a critical driving temperature below which there was a slight increase in elastic limit and tensile strength with ductility comparing favorably with that of the steel as rolled. When the critical temperature was exceeded there was a decided falling off in ductility, both elonga-

(*Please turn to Page 353*)

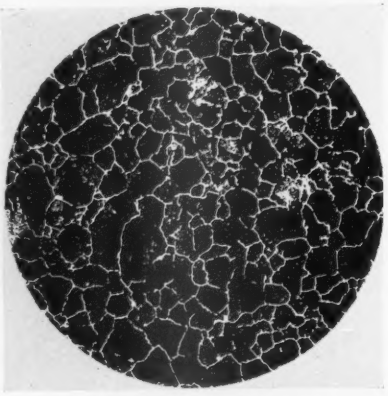


Fig. 5. McQuaid-Ehn grain characteristics of steel used in rivet sample No. 1—X-100. ✦

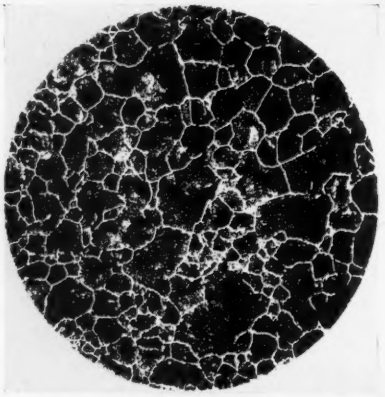


Fig. 6. McQuaid-Ehn test on steel used for rivet sample No. 2—X-100. ✦ ✦

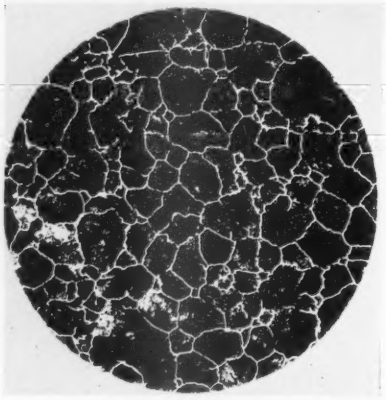


Fig. 7. McQuaid-Ehn test on steel used for rivet sample No. 3—X-100. ✦ ✦

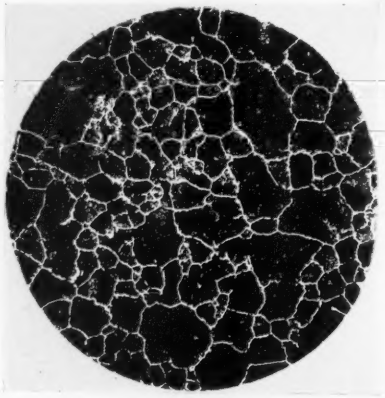


Fig. 8. McQuaid-Ehn test on steel used for rivet sample No. 4—X-100. ✦ ✦

TABLE I

Carbon	Phosphorus	Sulphur	Manganese
0.10% Max.	0.030% Max.	0.040% Max.	0.25 — 0.40%

TABLE II

Designation of Rivets	Hot Rolled Rod Size	No. of Drafts	Resulting Wire Size	Percent Reduction	Processing of Wire	No. of Drafts	Resulting Wire Size	Percent Reduction
1	9/32"	1	.243	25.3	None	..	...	...
2	9/32"	1	.250	20.9	5 hrs., 1150°F.	1	.243	5.5
3	5/16"	1	.262	29.6	5 hrs., 1150°F.	1	.243	13.9
4	5/16"	1	.250	36.0	5 hrs., 1150°F.	1	.243	5.5

TABLE 3

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

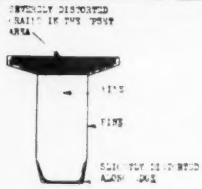


Fig. 9

Annealing Temperature	1200° F		
Annealing Time	10 minutes	1 hour	4 hours
Annealing Grain Size			
Head	Distorted		
Under the head	Fine		
Center of shank	Fine		
Edge of shank	Fine		
Tensile Strength			
Actual load	1890		
Lbs. per sq. inch	39700		
Shear Strength			
Actual load	3100		
Lbs. per sq. inch	42800		
Rockwell B Hardness			
Interior of shank	89.7		
Exterior of shank	82.7		

TABLE 4

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

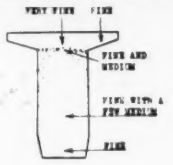


Fig. 10

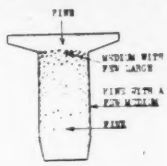


Fig. 11

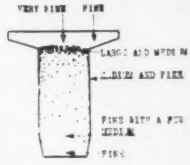


Fig. 12

Annealing Temperature	1200° F	1200° F	1200° F
Annealing Time	10 minutes	1 hour	4 hours
Annealing Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Fine and medium	Medium, a few large	Medium and large
Center of shank	Fine, a few medium	Fine, a few medium	Fine, a few medium
Edge of shank	Fine, a few medium	Fine, a few medium	Fine, a few medium
Tensile Strength			
Actual load	2350	2300	2260
Lbs. per sq. inch	49500	48400	47500
Shear Strength			
Actual load	1990	1980	1970
Lbs. per sq. inch	40600	40400	40200
Rockwell B Hardness			
Interior of shank	53.6	50.8	46.5
Exterior of shank	45.3	42.8	40.1

TABLE 5

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

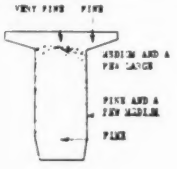


Fig. 13

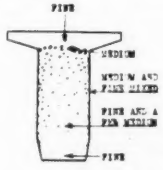


Fig. 14

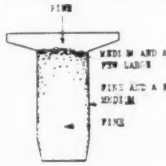


Fig. 15

Annealing Temperature	1250° F	1250° F	1250° F
Annealing Time	10 minutes	1 hour	4 hours
Annealing Grain Size			
Head	Very fine	Fine	Fine
Under the head	Medium, a few large	Medium, a few large	Medium and large
Center of shank	Fine, a few medium	Fine, a few medium	Fine, a few medium
Edge of shank	Fine, a few medium	Fine, a few medium	Fine, a few medium
Tensile Strength			
Actual load	2330	2285	2265
Lbs. per sq. inch	49000	48100	47600
Shear Strength			
Actual load	2000	1930	1800
Lbs. per sq. inch	40600	39400	36700
Rockwell B Hardness			
Interior of shank	53.2	50.2	46.7
Exterior of shank	42.9	42.4	40.6

TABLE 6

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

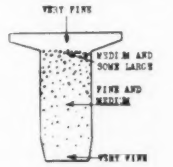


Fig. 16

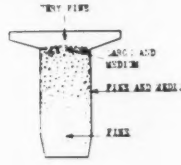


Fig. 17

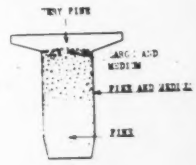


Fig. 18

Annealing Temperature	1300° F	1300° F	1300° F
Annealing Time	10 minutes	1 hour	4 hours
Annealing Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Medium, a few large	Medium and large	Medium and large
Center of shank	Fine and medium	Fine and medium	Fine and medium
Edge of shank	Fine and medium	Fine and medium	Fine and medium
Tensile Strength			
Actual load	2345	2280	2280
Lbs. per sq. inch	49400	48000	48000
Shear Strength			
Actual load	2000	1970	1960
Lbs. per sq. inch	40800	40250	40000
Rockwell B Hardness			
Interior of shank	53.0	52.5	45.7
Exterior of shank	42.7	41.1	38.7

TABLE 7

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

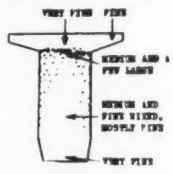


Fig. 19

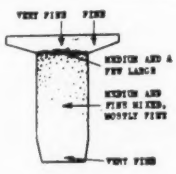


Fig. 20

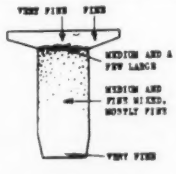


Fig. 21

Annealing Temperature	1350° F	1350° F	1350° F
Annealing Time	10 minutes	1 hour	4 hours
Annealing Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Medium, a few large	Medium, a few large	Medium, a few large
Center of shank	Fine and medium	Fine and medium	Fine and medium
Edge of shank	Fine and medium	Fine and medium	Fine and medium
Tensile Strength			
Actual load	2350	2310	2260
Lbs. per sq. inch	49500	48600	47500
Shear Strength			
Actual load	2025	2000	1980
Lbs. per sq. inch	41300	40800	40400
Rockwell B Hardness			
Interior of shank	53.3	51.6	48.8
Exterior of shank	41.9	38.8	36.8

TABLE 8

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

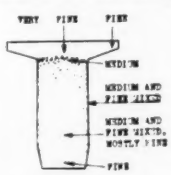


Fig. 22

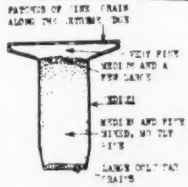


Fig. 23

Fig. 24

Annealing Temperature	1450° F	1450° F	1450° F
Annealing Time	10 minutes	1 hour	4 hours
Annealing Grain Size			
Head	Very fine	Very fine, coarse	Extremely coarse
Under the head	Medium	Medium, a few large	Medium
Center of shank	Fine and medium	Fine and medium	Fine and medium
Edge of shank	Fine and medium	Medium	Medium and large
Tensile Strength			
Actual load	2340	2300	2190
Lbs. per sq. inch	49200	48100	46100
Shear Strength			
Actual load	2000	1990	1980
Lbs. per sq. inch	40800	40600	40400
Rockwell B Hardness			
Interior of shank	51.6	51.2	50.2
Exterior of shank	41.6	36.2	34.4

TABLE 8

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

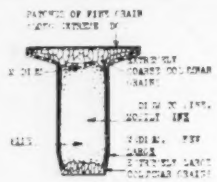


Fig. 25 | Fig. | Fig.

Annealing Temperature	1450° F		
Annealing Time	8 hours	1 hour	4 hours
Resulting Grain Size			
Head	Extremely coarse		
Under the head	Medium		
Center of shank	Fine and medium		
Edge of shank	Medium and large		
Tensile Strength			
Actual load			
Lbs. per sq. inch			
Shear Strength			
Actual load			
Lbs. per sq. inch			
Rockwell B Hardness			
Interior of shank	42.3		
Exterior of shank	33.2		

TABLE 9

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

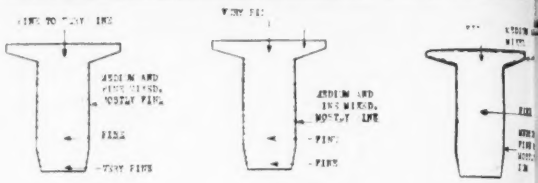


Fig. 26 | Fig. 27 | Fig. 28

Annealing Temperature	1450° F	1550° F	1550° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Fine, medium and
Under the head	Fine	Fine	Fine
Center of shank	Fine	Fine	Fine
Edge of shank	Fine and medium	Fine and medium	Fine and medi
Tensile Strength			
Actual load	2340	2320	2275
Lbs. per sq. inch	49200	48800	47900
Shear Strength			
Actual load	2140	2010	1990
Lbs. per sq. inch	43700	41000	40600
Rockwell B Hardness			
Interior of shank	53.8	51.6	49.5
Exterior of shank	48.5	47.5	44.4

TABLE 10

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

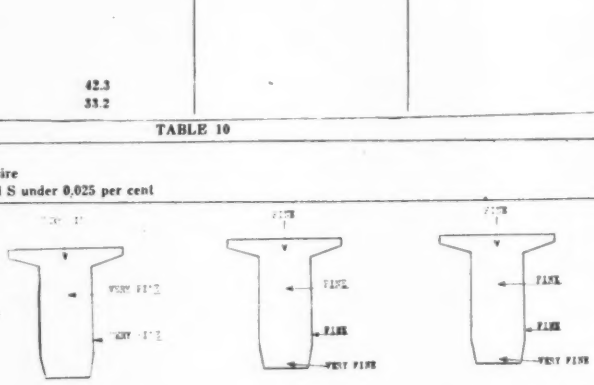


Fig. 29 | Fig. 30 | Fig. 31

Annealing Temperature	1650° F	1650° F	1650° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Fine	Fine
Under the head	Very fine	Fine	Fine
Center of shank	Very fine	Fine	Fine
Edge of shank	Very fine	Fine	Fine
Tensile Strength			
Actual load	2110	2400	2250
Lbs. per sq. inch	50700	50500	47300
Shear Strength			
Actual load	2030	2125	1995
Lbs. per sq. inch	41400	43400	40700
Rockwell B Hardness			
Interior of shank	57.6	56.1	54.6
Exterior of shank	51.3	53.2	49.1

TABLE 11

Rivet Sample No. 1
9/32" Rod drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

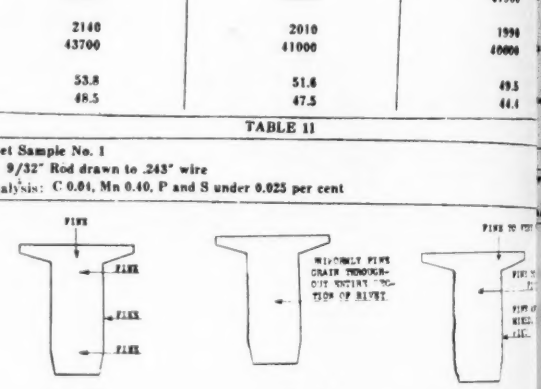


Fig. 32 | Fig. 33 | Fig. 34

Annealing Temperature	1750° F	1750° F	1750° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Fine	Fine	Fine
Under the head	Fine	Fine	Fine
Center of shank	Fine	Fine	Fine
Edge of shank	Fine	Fine	Fine and medi
Tensile Strength			
Actual load	2380	2350	2320
Lbs. per sq. inch	50100	49500	48800
Shear Strength			
Actual load	2000	2025	1950
Lbs. per sq. inch	40800	41300	39800
Rockwell B Hardness			
Interior of shank	55.1	55.4	53.3
Exterior of shank	51.0	51.1	47.7

TABLE 12

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

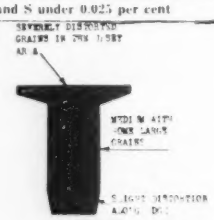


Fig. 35 | Fig. | Fig.

Annealing Temperature			
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Distorted		
Under the head	Medium, some large		
Center of shank	Medium, some large		
Edge of shank	Medium, some large		
Tensile Strength			
Actual load	1125		
Lbs. per sq. inch	29900		
Shear Strength			
Actual load	1830		
Lbs. per sq. inch	37300		
Rockwell B Hardness			
Interior of shank	72.3		
Exterior of shank	64.7		

TABLE 13

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

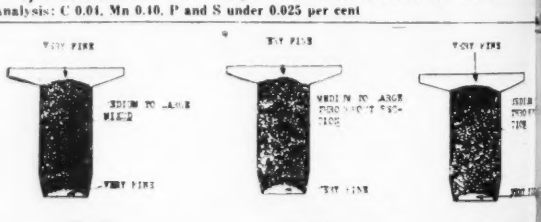


Fig. 36 | Fig. 37 | Fig. 38

Annealing Temperature	1200° F	1200° F	1200° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Medium to large	Medium to large	Medium to l
Center of shank	Medium to large	Medium to large	Medium to l
Edge of shank	Medium to large	Medium to large	Medium to l
Tensile Strength			
Actual load	2335	2280	2200
Lbs. per sq. inch	49100	48000	46300
Shear Strength			
Actual load	2045	1945	1900
Lbs. per sq. inch	41700	39700	38700
Rockwell B Hardness			
Interior of shank	59.8	59.3	53.1
Exterior of shank	46.8	46.6	44.2

TABLE 14

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

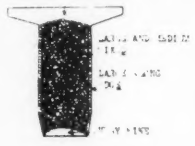


Fig. 39

Fig. 40

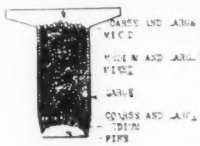


Fig. 41

Annealing Temperature	1250° F	1250° F	1250° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Large and medium	Large and medium	Large and medium
Center of shank	Large and medium	Large and medium	Large and medium
Edge of shank	Large	Large	Large
Tensile Strength			
Actual load	2280	2255	2210
Lbs. per sq. inch	48000	47400	46500
Shear Strength			
Actual load	2000	1925	1860
Lbs. per sq. inch	40800	39200	38000
Rockwell B Hardness			
Interior of shank	56.4	54.6	48.9
Exterior of shank	47.6	46.3	42.7

TABLE 15

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

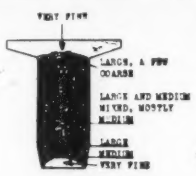


Fig. 42

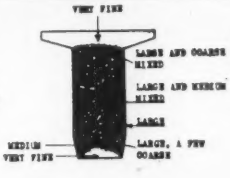


Fig. 43

Fig. 44

Annealing Temperature	1300° F	1300° F	1300° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Large, a few coarse	Large and coarse	Extremely coarse
Center of shank	Medium and large	Large and medium	Coarse, a few medium
Edge of shank	Large and medium	Large	Extremely coarse
Tensile Strength			
Actual load	2345	2260	2170
Lbs. per sq. inch	49100	47500	45600
Shear Strength			
Actual load	1980	1945	1870
Lbs. per sq. inch	40400	39700	38100
Rockwell B Hardness			
Interior of shank	58.3	55.5	53.0
Exterior of shank	51.7	46.7	35.3

TABLE 16

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

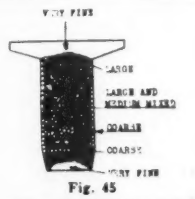


Fig. 45

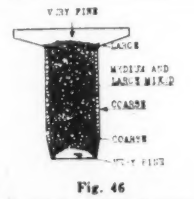


Fig. 46

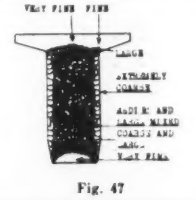


Fig. 47

Annealing Temperature	1350° F	1350° F	1350° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Large	Large	Large
Center of shank	Medium and large	Large and medium	Large and medium
Edge of shank	Coarse	Coarse	Extremely coarse
Tensile Strength			
Actual load	2350	2215	2120
Lbs. per sq. inch	49500	46600	44600
Shear Strength			
Actual load	2080	1925	1890
Lbs. per sq. inch	42400	39200	38600
Rockwell B Hardness			
Interior of shank	55.2	54.3	48.3
Exterior of shank	49.1	47.0	39.0

TABLE 17

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

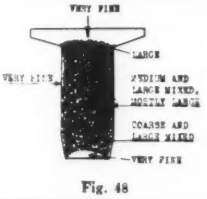


Fig. 48

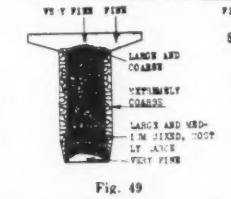


Fig. 49

Fig. 50

Annealing Temperature	1450° F	1450° F	1450° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Fine and coarse
Under the head	Large	Large and coarse	Coarse
Center of shank	Large and medium	Large and medium	Large and medium
Edge of shank	Large, some fine	Extremely coarse	Extremely coarse
Tensile Strength			
Actual load	2230	2050	2010
Lbs. per sq. inch	46900	43100	42300
Shear Strength			
Actual load	2020	1995	1730
Lbs. per sq. inch	41200	40700	35300
Rockwell B Hardness			
Interior of shank	53.8	53.0	43.9
Exterior of shank	42.1	30.2	22.7

TABLE 18

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

Fig. 51

Fig. 52

Fig. 53

Annealing Temperature	1550° F	1550° F	1550° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Fine, medium, large
Under the head	Large	Large	Large
Center of shank	Large and medium	Large and medium	Large and medium
Edge of shank	Large, a few coarse	Coarse	Extremely coarse
Tensile Strength			
Actual load	2245	2230	2090
Lbs. per sq. inch	47200	46900	44000
Shear Strength			
Actual load	1970	1970	2000
Lbs. per sq. inch	40250	40250	40800
Rockwell B Hardness			
Interior of shank	50.1	49.5	43.8
Exterior of shank	42.7	34.6	25.2

TABLE 19

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed drawn to .213" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

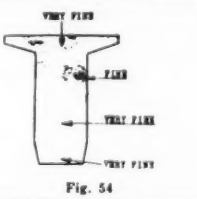


Fig. 54

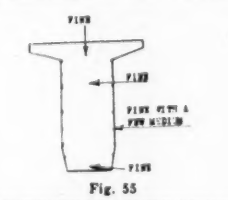


Fig. 55

Fig. 56

Annealing Temperature	1650° F	1650° F	1650° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Fine	Fine
Under the head	Very fine	Fine	Fine
Center of shank	Very fine	Fine	Fine
Edge of shank	Fine	Fine, a few medium	Fine, a few medium
Tensile Strength			
Actual load	2310	2250	2175
Lbs. per sq. inch	48600	47300	45700
Shear Strength			
Actual load	2030	1980	1970
Lbs. per sq. inch	41400	40400	40200
Rockwell B Hardness			
Interior of shank	53.9	53.8	51.9
Exterior of shank	49.8	46.9	46.5

TABLE 20

Rivet Sample No. 2
9/32" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

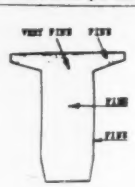


Fig. 57

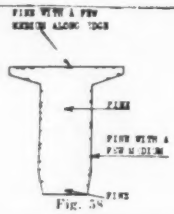


Fig. 58

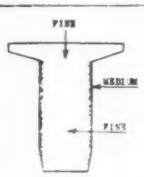


Fig. 59

Annealing Temperature	1750° F	1750° F	1750° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Fine	Fine
Under the head	Fine	Fine	Fine
Center of shank	Fine	Fine	Fine
Edge of shank	Fine	Fine, a few medium	Medium
Tensile Strength			
Actual load	2260	2235	2165
Lbs. per sq. inch	47500	47500	45500
Shear Strength			
Actual load	2230	2160	1900
Lbs. per sq. inch	45500	44000	38700
Rockwell B Hardness			
Interior of shank	52.9	44.7	44.5
Exterior of shank	46.6	37.1	34.6

TABLE 21

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

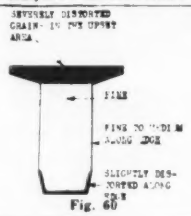


Fig. 60

	10 minutes	1 hour	4 hours
	Distorted		
	Fine		
	Fine		
	Fine to medium		
	1410		
	41200		
	1960		
	40000		
	80.1		
	68.5		

TABLE 22

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

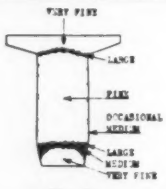


Fig. 61

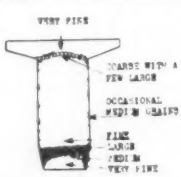


Fig. 62

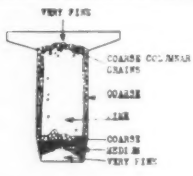


Fig. 63

Annealing Temperature	1200° F	1200° F	1200° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Large	Coarse, a few large	Coarse
Center of shank	Fine	Fine	Fine
Edge of shank	Fine, a few medium	Fine, a few medium	Coarse
Tensile Strength			
Actual load	2520	2500	2500
Lbs. per sq. inch	53000	52600	52600
Shear Strength			
Actual load	2070	2040	2020
Lbs. per sq. inch	42200	41600	41200
Rockwell B Hardness			
Interior of shank	67.6	62.4	62.2
Exterior of shank	56.5	51.7	49.4

TABLE 23

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

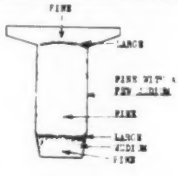


Fig. 64

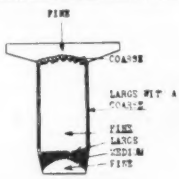


Fig. 65

Fig. 66

	1250° F	1250° F	1250° F
	10 minutes	1 hour	4 hours
	Fine	Fine	Fine
	Large	Coarse	Extremely coa
	Fine	Fine	Extremely coa
	Fine, a few medium	Large and coarse	Extremely coa
	2520	2480	2200
	53000	52200	46300
	2050	1980	1950
	43100	40100	39800
	65.6	60.4	46.9
	53.4	50.1	33.5

TABLE 24

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

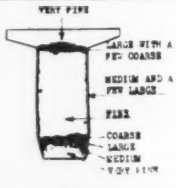


Fig. 67

Fig. 68

Fig. 69

Annealing Temperature	1300° F	1300° F	1300° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Large, a few coarse	Exremely coarse	Extremely coarse
Center of shank	Fine	Fine	Extremely coarse
Edge of shank	Medium, a few large	Extremely coarse	Extremely coarse
Tensile Strength			
Actual load	2430	2255	2150
Lbs. per sq. inch	51100	47400	45200
Shear Strength			
Actual load	2080	2075	1985
Lbs. per sq. inch	42100	42300	40500
Rockwell B Hardness			
Interior of shank	59.0	57.2	41.1
Exterior of shank	47.9	46.3	37.8

TABLE 25

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

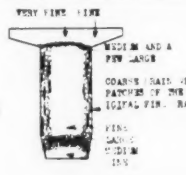


Fig. 70

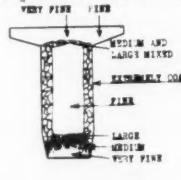


Fig. 71

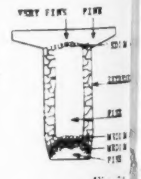


Fig. 72

	1350° F	1350° F	1350° F
	10 minutes	1 hour	4 hours
	Very fine	Very fine	Very fine
	Medium, a few large	Medium and large	Medium and
	Fine	Fine	Fine
	Coarse, some fine	Extremely coarse	Extremely co
	2300	2310	2060
	52600	48600	43700
	2075	2050	2000
	42300	41800	40800
	61.9	58.1	56.1
	40.1	29.2	27.9

TABLE 26

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.10, P and S under 0.025 per cent

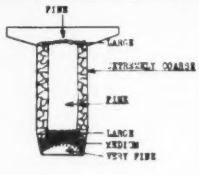


Fig. 73

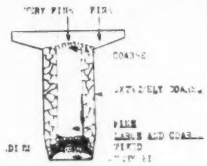


Fig. 74

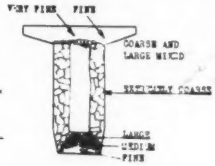


Fig. 75

Annealing Temperature	1150° F	1150° F	1150° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Large	Coarse	Coarse
Center of shank	Fine	Fine	Fine
Edge of shank	Extremely coarse	Extremely coarse	Extremely coarse
Tensile Strength			
Actual load	2260	2210	2025
Lbs. per sq. inch	47500	47100	42600
Shear Strength			
Actual load	2020	1940	1880
Lbs. per sq. inch	41200	39600	38300
Rockwell B Hardness			
Interior of shank	57.2	56.6	51.0
Exterior of shank	32.3	31.7	26.4

TABLE 26

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.10, P and S under 0.025 per cent

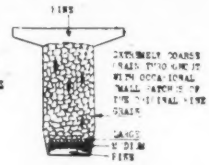


Fig. 76

Annealing Temperature	1150° F	Fig.	Fig.
Annealing Time	8 hours	1 hour	4 hours
Resulting Grain Size			
Head	Fine		
Under the head	Extremely coarse		
Center of shank	Extremely coarse		
Edge of shank	Extremely coarse		
Tensile Strength			
Actual load			
Lbs. per sq. inch			
Shear Strength			
Actual load			
Lbs. per sq. inch			
Rockwell B Hardness			
Interior of shank	32.3		
Exterior of shank	15.8		

TABLE 27

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.10, P and S under 0.025 per cent

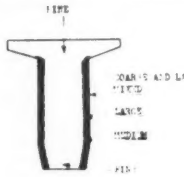


Fig. 77

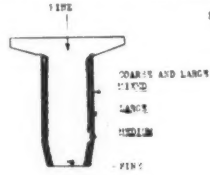


Fig. 78

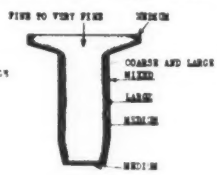


Fig. 79

Annealing Temperature	1550° F	1550° F	1550° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Fine	Fine	Fine, some medium
Under the head	Fine	Fine	Fine
Center of shank	Fine	Fine	Fine
Edge of shank	Coarse, large, medium	Coarse, large, medium	Coarse, large, medium
Tensile Strength			
Actual load	2265	2170	2160
Lbs. per sq. inch	47600	45600	45400
Shear Strength			
Actual load	1950	1890	1870
Lbs. per sq. inch	39800	38600	38100
Rockwell B Hardness			
Interior of shank	54.7	51.8	43.4
Exterior of shank	40.7	35.9	32.3

TABLE 28

Rivet Sample No. 3
5/16" Rod drawn to .262" wire, process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.10, P and S under 0.025 per cent

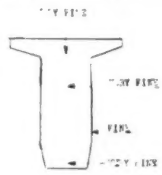


Fig. 80

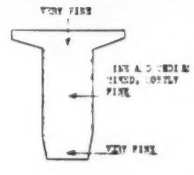


Fig. 81

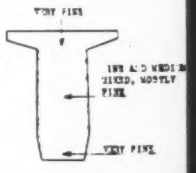


Fig. 82

Annealing Temperature	1650° F	1650° F	1650° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Very fine	Fine, some medium	Fine, some medium
Center of shank	Very fine	Fine, some medium	Fine, some medium
Edge of shank	Fine	Fine, some medium	Fine, some medium
Tensile Strength			
Actual load	2310	2240	2175
Lbs. per sq. inch	48600	47100	45700
Shear Strength			
Actual load	2050	2030	1995
Lbs. per sq. inch	41800	41400	40700
Rockwell B Hardness			
Interior of shank	56.2	53.1	51.1
Exterior of shank	44.5	42.7	41.6

TABLE 29

Rivet Sample No. 3
5/16" Rod drawn to .262" wire process annealed, drawn to .213" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

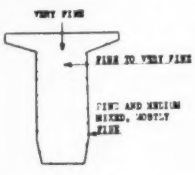


Fig. 83

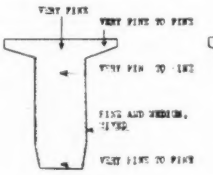


Fig. 84

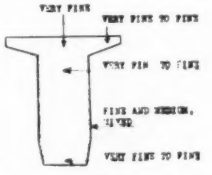


Fig. 85

Annealing Temperature	1750° F	1750° F	1750° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Fine	Fine	Fine
Center of shank	Fine	Fine	Fine
Edge of shank	Fine, a few medium	Fine and medium	Fine and medium
Tensile Strength			
Actual load	2310	2260	2220
Lbs. per sq. inch	48600	47500	46700
Shear Strength			
Actual load	2220	2150	2010
Lbs. per sq. inch	45300	43800	41000
Rockwell B Hardness			
Interior of shank	58.4	58.4	56.0
Exterior of shank	45.9	41.2	37.8

TABLE 30

Rivet Sample No. 1
5/16" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.10, P and S under 0.025 per cent

Fig. 86

Annealing Temperature	10 minutes	Fig. 1 hour	Fig. 4 hours
Annealing Time			
Resulting Grain Size			
Head	Distorted		
Under the head	Fine		
Center of shank	Fine		
Edge of shank	Fine		
Tensile Strength			
Actual load	1375		
Lbs. per sq. inch	28900		
Shear Strength			
Actual load	1860		
Lbs. per sq. inch	37900		
Rockwell B Hardness			
Interior of shank	78.0		
Exterior of shank	71.5		

TABLE 31

Rivet Sample No. 4
5/16" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

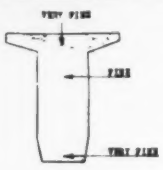


Fig. 87

Annealing Temperature	1200° F
Annealing Time	10 minutes
Resulting Grain Size	
Head	Very fine
Under the head	Fine
Center of shank	Fine
Edge of shank	Fine
Tensile Strength	
Actual load	2520
Lbs. per sq. inch	53000
Shear Strength	
Actual load	2020
Lbs. per sq. inch	41200
Rockwell B Hardness	
Interior of shank	67.1
Exterior of shank	56.2

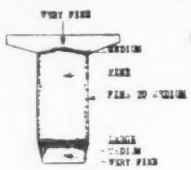


Fig. 88

Annealing Temperature	1200° F
Annealing Time	1 hour
Resulting Grain Size	
Head	Very fine
Under the head	Medium
Center of shank	Fine
Edge of shank	Fine to medium
Tensile Strength	
Actual load	2500
Lbs. per sq. inch	52600
Shear Strength	
Actual load	2020
Lbs. per sq. inch	41200
Rockwell B Hardness	
Interior of shank	63.0
Exterior of shank	55.0

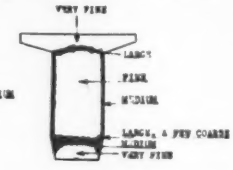


Fig. 89

Annealing Temperature	1200° F
Annealing Time	4 hours
Resulting Grain Size	
Head	Very fine
Under the head	Large
Center of shank	Fine
Edge of shank	Medium
Tensile Strength	
Actual load	2430
Lbs. per sq. inch	51100
Shear Strength	
Actual load	1970
Lbs. per sq. inch	40200
Rockwell B Hardness	
Interior of shank	62.7
Exterior of shank	52.2

TABLE 32

Rivet Sample No. 4
5/16" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

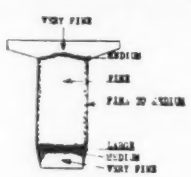


Fig. 90

Annealing Temperature	1250° F
Annealing Time	10 minutes
Resulting Grain Size	
Head	Very fine
Under the head	Medium
Center of shank	Fine
Edge of shank	Fine to medium
Tensile Strength	
Actual load	2500
Lbs. per sq. inch	52600
Shear Strength	
Actual load	2040
Lbs. per sq. inch	41600
Rockwell B Hardness	
Interior of shank	64.0
Exterior of shank	56.8

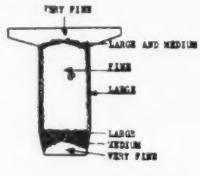


Fig. 91

Annealing Temperature	1250° F
Annealing Time	1 hour
Resulting Grain Size	
Head	Very fine
Under the head	Large and medium
Center of shank	Fine
Edge of shank	Large
Tensile Strength	
Actual load	2425
Lbs. per sq. inch	51000
Shear Strength	
Actual load	2030
Lbs. per sq. inch	41400
Rockwell B Hardness	
Interior of shank	63.4
Exterior of shank	54.1

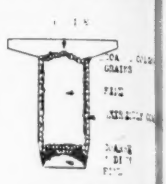


Fig. 92

Annealing Temperature	1250° F
Annealing Time	4 hours
Resulting Grain Size	
Head	Very fine
Under the head	Coarse
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2315
Lbs. per sq. inch	48700
Shear Strength	
Actual load	1925
Lbs. per sq. inch	39200
Rockwell B Hardness	
Interior of shank	58.7
Exterior of shank	43.0

TABLE 33

Rivet Sample No. 4
5/16" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

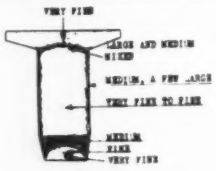


Fig. 93

Annealing Temperature	1300° F
Annealing Time	10 minutes
Resulting Grain Size	
Head	Very fine
Under the head	Large and medium
Center of shank	Very fine to fine
Edge of shank	Medium, a few large
Tensile Strength	
Actual load	2500
Lbs. per sq. inch	52600
Shear Strength	
Actual load	2060
Lbs. per sq. inch	42000
Rockwell B Hardness	
Interior of shank	66.4
Exterior of shank	55.3

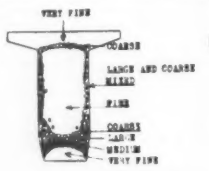


Fig. 94

Annealing Temperature	1300° F
Annealing Time	1 hour
Resulting Grain Size	
Head	Very fine
Under the head	Coarse
Center of shank	Fine
Edge of shank	Large and coarse
Tensile Strength	
Actual load	2410
Lbs. per sq. inch	50700
Shear Strength	
Actual load	1950
Lbs. per sq. inch	39800
Rockwell B Hardness	
Interior of shank	65.1
Exterior of shank	49.3

Fig. 95

Annealing Temperature	1300° F
Annealing Time	4 hours
Resulting Grain Size	
Head	Very fine
Under the head	Coarse
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2260
Lbs. per sq. inch	47500
Shear Strength	
Actual load	1950
Lbs. per sq. inch	39800
Rockwell B Hardness	
Interior of shank	58.1
Exterior of shank	40.6

TABLE 34

Rivet Sample No. 4
5/16" Rod drawn to .250" wire, process annealed drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

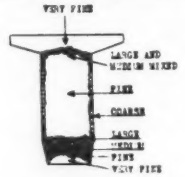


Fig. 96

Annealing Temperature	1350° F
Annealing Time	10 minutes
Resulting Grain Size	
Head	Very fine
Under the head	Large and medium
Center of shank	Fine
Edge of shank	Coarse
Tensile Strength	
Actual load	2505
Lbs. per sq. inch	52700
Shear Strength	
Actual load	2060
Lbs. per sq. inch	42000
Rockwell B Hardness	
Interior of shank	63.5
Exterior of shank	54.0

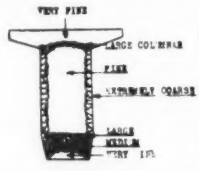


Fig. 97

Annealing Temperature	1350° F
Annealing Time	1 hour
Resulting Grain Size	
Head	Very fine
Under the head	Large
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2380
Lbs. per sq. inch	50100
Shear Strength	
Actual load	2060
Lbs. per sq. inch	42000
Rockwell B Hardness	
Interior of shank	63.3
Exterior of shank	44.9

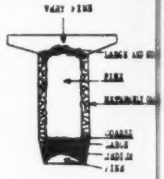


Fig. 98

Annealing Temperature	1350° F
Annealing Time	4 hours
Resulting Grain Size	
Head	Very fine
Under the head	Large
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2310
Lbs. per sq. inch	48800
Shear Strength	
Actual load	2020
Lbs. per sq. inch	41200
Rockwell B Hardness	
Interior of shank	60.1
Exterior of shank	39.7

TABLE 35

Rivet Sample No. 4
5/16" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

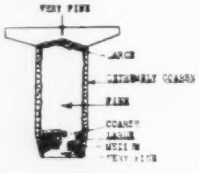


Fig. 99

Annealing Temperature	1450° F
Annealing Time	10 minutes
Resulting Grain Size	
Head	Very fine
Under the head	Large
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2400
Lbs. per sq. inch	50500
Shear Strength	
Actual load	1960
Lbs. per sq. inch	40000
Rockwell B Hardness	
Interior of shank	62.4
Exterior of shank	46.9

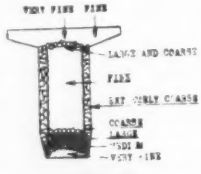


Fig. 100

Annealing Temperature	1450° F
Annealing Time	1 hour
Resulting Grain Size	
Head	Very fine
Under the head	Large and coarse
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2340
Lbs. per sq. inch	49200
Shear Strength	
Actual load	1900
Lbs. per sq. inch	38700
Rockwell B Hardness	
Interior of shank	58.5
Exterior of shank	36.2

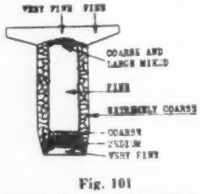


Fig. 101

Annealing Temperature	1450° F
Annealing Time	4 hours
Resulting Grain Size	
Head	Very fine
Under the head	Coarse and large
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2175
Lbs. per sq. inch	45700
Shear Strength	
Actual load	1820
Lbs. per sq. inch	37100
Rockwell B Hardness	
Interior of shank	56.7
Exterior of shank	29.6

TABLE 36

Rivet Sample No. 4
5/16" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

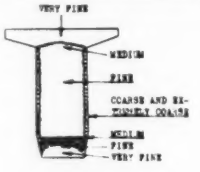


Fig. 102

Annealing Temperature	1550° F
Annealing Time	10 minutes
Resulting Grain Size	
Head	Very fine
Under the head	Medium
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2325
Lbs. per sq. inch	48900
Shear Strength	
Actual load	2100
Lbs. per sq. inch	42800
Rockwell B Hardness	
Interior of shank	57.6
Exterior of shank	43.6

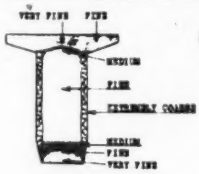


Fig. 103

Annealing Temperature	1550° F
Annealing Time	1 hour
Resulting Grain Size	
Head	Very fine
Under the head	Medium
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2275
Lbs. per sq. inch	47900
Shear Strength	
Actual load	2060
Lbs. per sq. inch	42000
Rockwell B Hardness	
Interior of shank	56.5
Exterior of shank	38.7

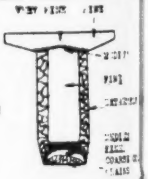


Fig. 104

Annealing Temperature	1550° F
Annealing Time	4 hours
Resulting Grain Size	
Head	Very fine
Under the head	Medium
Center of shank	Fine
Edge of shank	Extremely coarse
Tensile Strength	
Actual load	2270
Lbs. per sq. inch	47800
Shear Strength	
Actual load	2020
Lbs. per sq. inch	41200
Rockwell B Hardness	
Interior of shank	56.0
Exterior of shank	31.9

tion and reduction in area decreasing with increase in temperature.

✦ ✦ ✦

IN this latter instance, while no photomicrographs were made, it is believed that a metallographic study of the **McQuaid-Ehn** structures and the resulting grain sizes at various temperature levels would have shown a satisfactory correlation to enable the investigator to predict beforehand the relative suitability of various steels of widely divergent **McQuaid-Ehn** structures. In this regard it must be stated that the **McQuaid-Ehn** test measures the grain characteristics at 1700 degrees F. only. **Herty, McBride and Hollenback (9)** have shown that coarse grained steels as indicated by the standard **McQuaid-Ehn** test at 1700 degrees F. may be fine grained at lower temperatures, so that in some instances it may be very misleading to attempt to predict behavior at temperatures other than that of the test.

✦ ✦ ✦

Materials

THE grade of steel used in the manufacture of rivets in the present investigation conformed to the general classification shown in Table I.

✦ ✦ ✦

THE **McQuaid-Ehn** grain structures showed all of the steels used in this investigation to be consistently alike in grain size and degree of abnormality, Figures 5, 6, 7 and 8 show the McQuaid-Ehn structure of these steels and reveal a medium sized grain, approximately No. 4 according to the A. S. T. M. classification, with a slight degree of abnormality.

✦ ✦ ✦

THE rivets were made from rods and wire according to the schedule shown in Table II.

✦ ✦ ✦

THE heat treatment schedule for each of the four types of rivets indicated in Table II consisted of heating the samples for 10 minutes, 1 hour and 4 hours at the following temperature levels, namely: 1200°, 1250°, 1300°, 1350°, 1450°, 1550°, 1650°, and 1750° F.

✦ ✦ ✦

THE results of a complete metallographic study are indicated by a series of diagrams at the top of each of the following data sheets drawn approximately to scale but with slightly exaggerated grain size. Additional data from physical tests are also included and are tabulated in columns under the proper sample. Actual photomicrographs illustrating the various "standard" grain sizes indicated on the diagrams are shown in Figures 115 through 121 following the data sheets.

TABLE 37

Rivet Sample No. 1
5/16" Rod drawn to .250" wire, process annealed drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

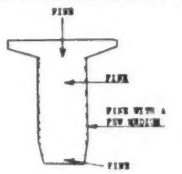


Fig. 105

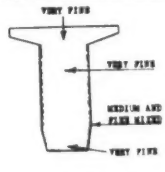


Fig. 106

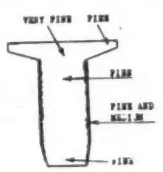


Fig. 107

Annealing Temperature	1650° F	1650° F	1650° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Fine	Fine	Fine
Center of shank	Fine	Fine	Fine
Edge of shank	Fine and medium	Medium and fine	Medium and fine
Tensile Strength			
Actual load	2415	2405	2320
Lbs. per sq. inch	50800	50600	48800
Shear Strength			
Actual load	2175	2110	2060
Lbs. per sq. inch	41400	43000	42000
Rockwell B Hardness			
Interior of shank	62.5	58.1	57.5
Exterior of shank	48.3	45.6	43.6

TABLE 38

Rivet Sample No. 4
5/16" Rod drawn to .250" wire, process annealed, drawn to .243" wire
Analysis: C 0.04, Mn 0.40, P and S under 0.025 per cent

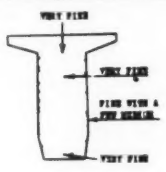


Fig. 108

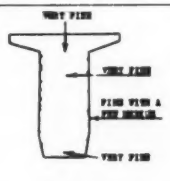


Fig. 109

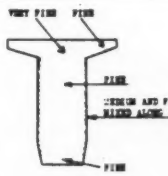


Fig. 110

Annealing Temperature	1750° F	1750° F	1750° F
Annealing Time	10 minutes	1 hour	4 hours
Resulting Grain Size			
Head	Very fine	Very fine	Very fine
Under the head	Very fine	Very fine	Fine
Center of shank	Very fine	Very fine	Fine
Edge of shank	Fine, a few medium	Fine, a few medium	Medium and fine
Tensile Strength			
Actual load	2380	2310	2310
Lbs. per sq. inch	50100	49200	48600
Shear Strength			
Actual load	2145	2055	2080
Lbs. per sq. inch	43700	41900	42100
Rockwell B Hardness			
Interior of shank	59.8	57.3	54.1
Exterior of shank	48.6	42.2	35.2

This paper to be published in three parts.

Part II (August) will contain:

1. Microphotographs of etched surfaces of rivets.
2. Continuation of discussion of grain growth.

Part III (September) will contain:

1. Tensile test data.
2. Miscellaneous physical strength data.
3. Hardness data.
4. Summary.
5. Bibliography.

TENTATIVE PROGRAM
STEEL DIVISION
FOR WIRE ASSOCIATION CONVENTION AT DETROIT, MICH., OCT. 17-21, 1938

PAPERS	AUTHORS	COMPANY
TUESDAY, OCT. 18th:		
Lecture: "Principles of Metallurgy"	B. L. McCarthy, Metallurgist	Wickwire-Spencer Steel Co., Buffalo, N. Y.
"Wire Screens—Uses & Grades"	R. B. Roth, Purch. Agent	Ludlow-Saylor Wire Co., St. Louis, Mo.
"Effect of Under Critical Annealing Treatments on Cold Drawn Steels"	F. C. Brandon, Metallurgist	Union Drawn Steel Div., Republic Steel Corp., Massillon, Ohio
"Cold Heading"	H. L. Hopkins, Metallurgist	National Screw & Mfg. Co., Cleveland, Ohio
WEDNESDAY, OCT. 19th:		
Lecture: "Thermal Reactions"	B. L. McCarthy, Metallurgist	Wickwire-Spencer Steel Co., Buffalo, N. Y.
"Wire Association Annual Meeting"		
Acid Disposal Symposium	L. F. Marek, Chem. Eng.	Arthur D. Little, Inc., Cambridge, Mass.
	S. F. Spangler, Chem. Eng.	Chemical Construction Corp., N. Y. C.
	Dr. Otto Mantius, Consulting Eng.	National Lead Co., (Acid Recovery Dept.), New York, N. Y.
THURSDAY, OCT. 20th:		
Lecture: "Metallurgy of Steel Wire"	B. L. McCarthy, Metallurgist	Wickwire-Spencer Steel Co., Buffalo, N. Y.
"Stainless Steel Wire"	J. K. Findley, Metallurgist	Ludlum Steel Co., Dunkirk, N. Y.
"Rope Wire"	W. R. Bloxdorf, Metallurgist	MacWhyte Co., Kenosha, Wisc.
"Wire Rope"	H. K. Hammerstein, Chief Eng.	Broderick & Bascom Rope Co., St. Louis, Mo.

Program of the Non-Ferrous Division Will be Announced in August Issue of Wire and Wire Products

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Vol. 13 JULY, 1938 No. 7

The Manufacture of Spring Wire From Low Carbon Steel

By Dr. Hans Wiescke,

Of Duisburg*

PART I

A study of the hardening properties of low carbon steel (.10 carbon and below) and the adaptability of such steel for the manufacture of spring wire and wire products. Published in two parts. ✦ ✦ ✦ ✦

TECHNICAL literature carries very little notice of the hardening properties of low carbon steel, (.10 carbon and below) and such data as exists is given only as incidental to other researches. **L. Campredon (1) M. G. Charpy (2) A. Le Chatalier (3) H. M. Howe (4) J. O. Arnold (5) J. A. Brinell and A. Wahlberg (6) Joisten (7) Kühnel (8) O. Bauer (9)** and in recent years **M. Sauvageot and H. Delmas (10) F. Wüst** and **W. C. Huntington (11) H. Hahnemann and A. Schrader (12)** and **Ed. Maurer (13)** have reported a moderate but invariable hardening ability in low carbon steel. For the most part they have not pursued the subject further, although a greater familiarity with this phenomenon would surely seem essential to a thorough knowledge of that grade of steel which comprises about 75% of the total steel tonnage. This is partly due to the fact that the steel industry did not encourage such research, and as a result the use of hardened low carbon steel has until quite recently been confined to a few districts.

✦ ✦ ✦

DURING the war, and the shortage of copper and the red brasses, shell cases, cartridge cases, and rifling bands were made of hardened low carbon steel. In 1922 **Roy H. Smith (14)** first described the quenching of soft steel for improvement of bolts and rivets. In 1925 the technique was so fully developed that it could be incorporated into production schedule, and a full description of the process was published by **R. H. Smith** and **E. L. Shaner (15).**

✦ ✦ ✦

THE wire industry is the only branch of the trade that has taken advantage on a large scale of the hardening capabilities of low carbon steel, and its activities have been chiefly in connection with the preparation of a raw material for spring wire. The practise seems to have become known first in the Upper Silesian district at Gleiwitz. The wire is commonly described in the trade as "water-hardened". The properties required of the raw material are springiness and ability to stand cold knotting, after drafting. These requirements are met by a low carbon steel whose yield point has been raised by hardening.

✦ ✦ ✦

THE greatest difficulty in the manufacture of spring wire is in securing uniformity. The source of the difficulties may be found in

(a) The peculiarities of the rod mill involved, and the rolling technique.
(b) The particular steel in question.
(c) The quenching technique.
(d) Details of further working.

✦ ✦ ✦

IN order to properly appreciate the degree of control possible in this matter it is useful to study an average plant which controls the raw material, the blooming and billet rolling and the rolling of the rod. The size of the rod is of considerable importance, as are also the rolling speed and speed of cooling in the mill and the rod temperature between the last pass and the reel.

*Translated from Stahl und Eisen by Kenneth B. Lewis, Consulting Wire Mill Engineer, Worcester, Mass.

Fig. 1. Influence of rod size on finishing temperature.

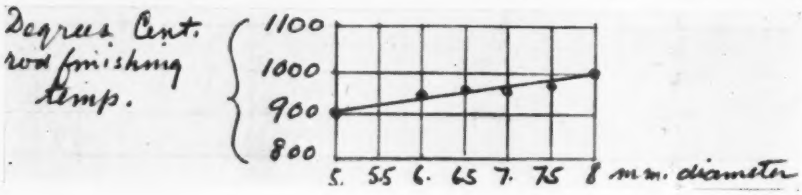
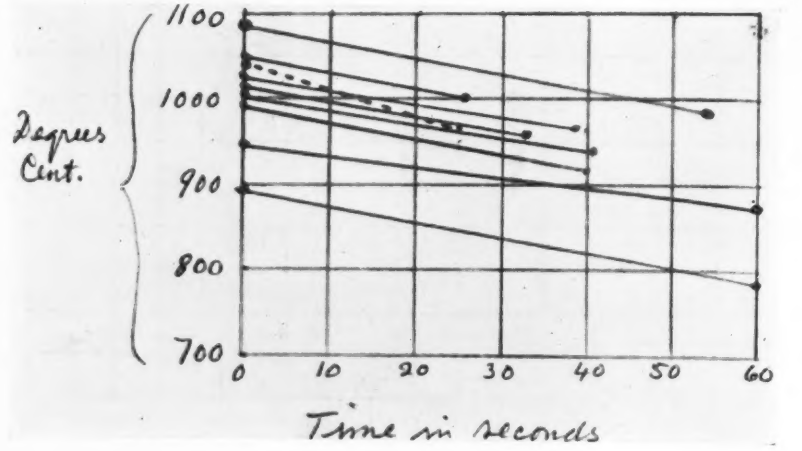
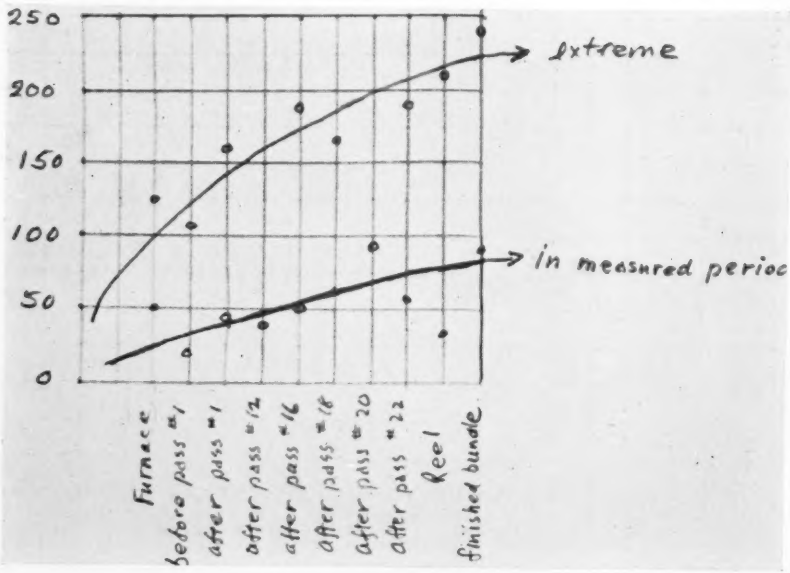


Fig. 2. Influence of rod size on rate of cooling.



Full diagonals, top to bottom.
1. 5 mm. (high speed rolling)
2. 8 mm.
3. 6.5 mm.
4. 7 mm. entered cold
5. 6 mm.
6. mean speed, 1.5° per second
7. 5 mm. normal working
8. 5 mm. entered cold
Dotted line is 7.5 mm.

Fig. 3. Temperature fluctuations during rolling.



THE finishing temperatures of various rod sizes are shown in figure 1, from which it is seen that an 8 mm. rod finishes about 100° C. hotter than a 5 mm. The rate of cooling appears to run in parallel lines, (fig. 2). The limits between which the temperature can fluctuate between the last pass and the reel are shown in fig. 3. The influence of hot work on grain size is shown in fig. 4. The coarsening of grain, in the finished rod, where shown, is presumably due to finishing at too low a temperature. The properties of the rod are influenced by the finishing temperature and by the reduction in the last pass (7). A temperature just above A_3 produces the finest grain and the highest yield point.

✦ ✦ ✦

Manufacture of Spring Rods

THE hardening of rods direct from the rolls by the use of water can be accomplished either by coiling the rods under water or by dumping the coiled bundle direct from the reel into a water bosh.

✦ ✦ ✦

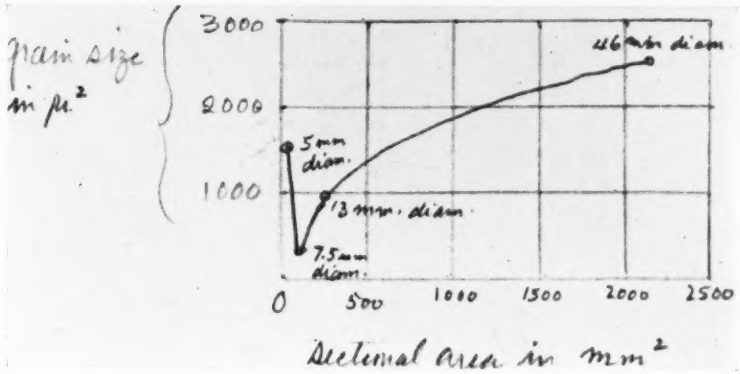
EDENBORN reels are set under water, which is conveyed to them by various arrangements of pipes of at least 6 inch diameter, so that each convolution of hot rod is separately quenched. In the case of a Garrett reel the water is brought in over the top of the reel by a pipe of 6 to 10 inches in diameter, discharging through

several branches close to the edge of the reel casing. The water in most cases discharges through the bottom of the reel. In recent years **Demag** of Duisburg and **Hermann Böcher** of Cologne have brought out combination Edenborn-Garrett reels with automatic closures at the bottom. (see Fig. 5c). **Böcher** also supplies a Garrett reel direct-coupled to a vertical motor. In cases where the rod is not coiled under water the coiled bundle is dumped into a bosh filled with running water, located directly under the reel. A recent installation supplies one cubic meter of water per bundle. All these arrangements are indicated in outline in Fig. 5, a to d.

✦ ✦ ✦

TABLE 1 gives a summary of steel specifications and methods of handling for a group of plants. Basic converter steel is used almost exclusively and unless otherwise stated is made at the plant in question. It is generally rolled on small mills, and starts at about a 2″ billet. This practise has the advantage of promoting uniform heating, and of giving a relatively fast run-off of the rod, with minimum cooling in the mill. The bundle weight is held down for the same reason, to give a high and uniform finishing temperature. For quenching, the Edenborn or the reel with closed bottom seem best adapted, for they not only give a better and more uniform quench, but require less waste of water than the open-bottomed Garrett. The rods run chiefly 5 to 7 mm. The increase of tensile strength due to quenching ranges from 14000 to 28000 lbs. per square inch. The increased strength impressed upon the stock varies from plant to plant. While plant A, for example, regards 88,000 as the lower limit for spring rod, plant D, which formerly worked to the same figure has dropped back to 77,000 on the ground of better uniformity. Plant F, trying for the highest possible strength reaches 120,000, a figure which plant D has attained at times.

Fig. 4. Grain size developed in rod in relation to rod section area.



✦ ✦ ✦

THE necessity of a drastic quench is emphasized by all these plants, and all complain about non-uniformity. Plant D, working to the lower limits, gets the best uniformity, fully as good in the quenched as in unquenched steel.

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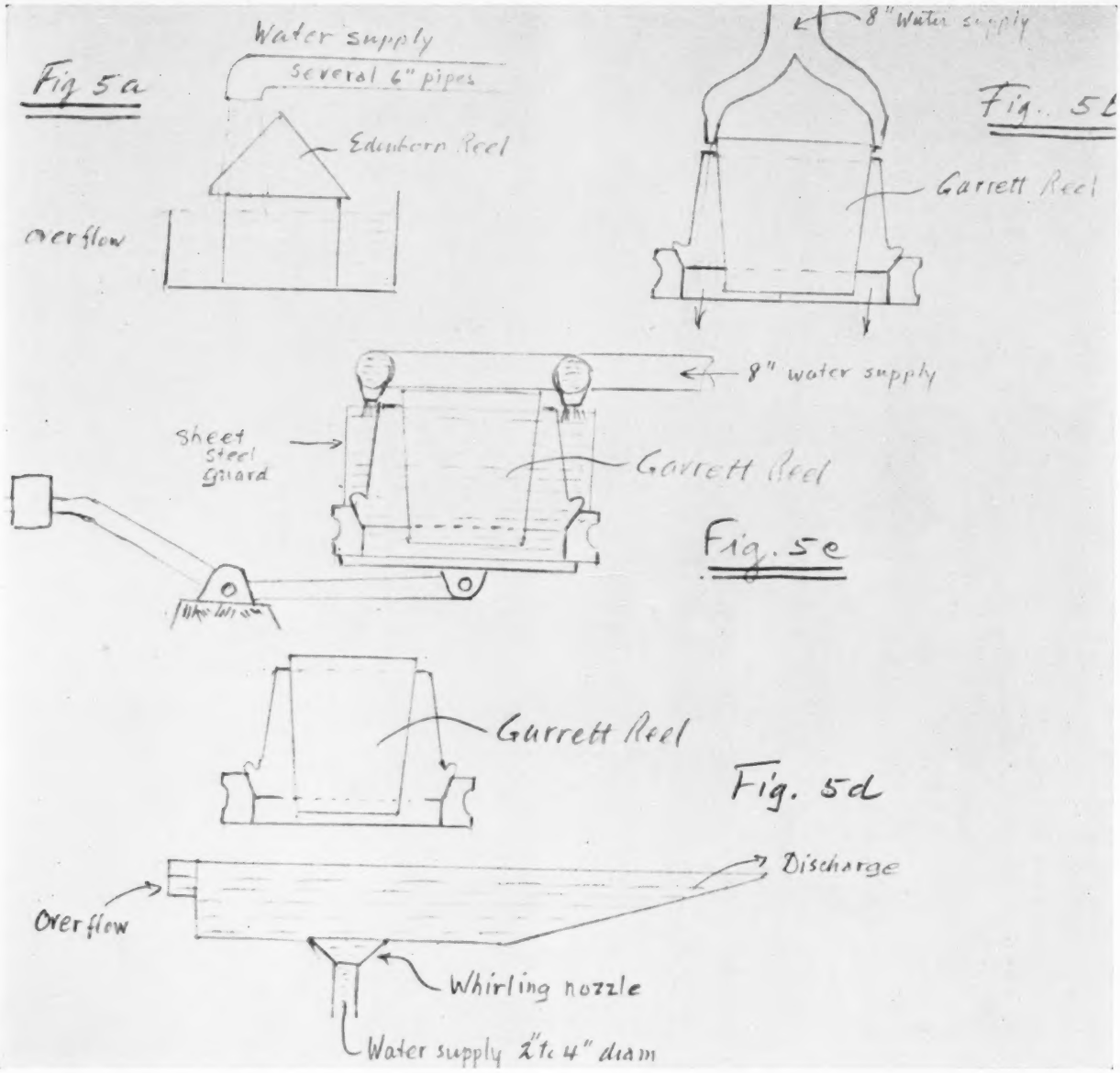
THE structure characteristic of most water-hardened rod is shown in Fig. 6, but it must be noted that occasionally the structure appears like a perfectly normal ferrite aggregate and yet shows the same physical properties as the

TABLE 1—COMPOSITION AND DETAILS OF PRACTISE

Plant	Composition C	Composition P	Composition S	Method of steel making	billet size m m square	Kind of Reel	Method of quenching	Output per 10 hr. shift	tensile normal (lbs. per sq. in.)	tensile quenched (lbs. per sq. in.)	Rod dia. mm.
A	.05 to .06	.06 max	—	basic conv.	50	Edenborn	on reel	60±	60000	88000	6
B	.04 to .08	max .08	—	basic conv. from plant C	50	Garrett	on reel	60±	52000 to 62000	77000±	5/5.5
C	ordinary basic converter steel			basic conv.	130	Garrett	reel and bosh	230/240	52000 to 62000	91000 to 98000	—
D	ditto			basic conv.	50	Edenborn	on reel	50	56000 to 70000	77000 to 91000	6/6.3
E	same as A			basic conv. from plant A	40-50	Edenborn	bosh	45	56000 to 70000	77000 to 91000	6
F	.05 to .12	high		basic O. H.	125	Garrett	reel and bosh	230/240	49000 to 59000	92000 to 101000	6
G	— (soft)	at least .06		basic conv.	—	—	—	—	63000	91000	6
B	same as G			basic conv.	—	Edenborn	on reel	50	—	—	—



steels with typical quenched structure. On this peculiarity opinions differ, and further research is desirable.

✦ ✦ ✦

IT must be conceded that the effects of quenching on low carbon steels are small, compared with the same possibilities in high carbon steel. Never-the-less, quenching soft steel can give rise to irregularities that are extremely troublesome.

✦ ✦ ✦

Chemical Composition

CARBON in small amounts has a profound influence on quenching possibilities. The same is true of manganese, but its influence appears only when it passes .50%. In the usual percentages, .25 to .45 the influence of manganese seems to be negligible. **Campredon (1)** and **Maurer (13)** the latter supporting the researches of **Hanemann** and **Schrader (12)** as well as those of **Sauvageot** and **Delmas (10)** attribute the hardening of low carbon steel to the combination of carbon with manganese. It is true that the hardening begins at a manganese content of about .50. Steel with .05 carbon and .57 manganese was found excellent for spring wire. The tensile after quenching reached 93,000 lbs. per square inch, with 12% elongation, and steel with .105

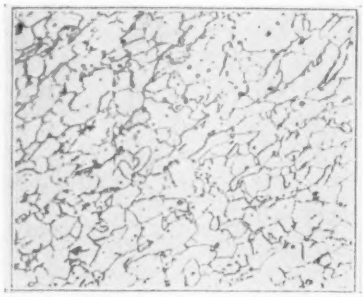


Fig. 6. Quenched low carbon rod. ✦

(*Please turn to Page 378*)

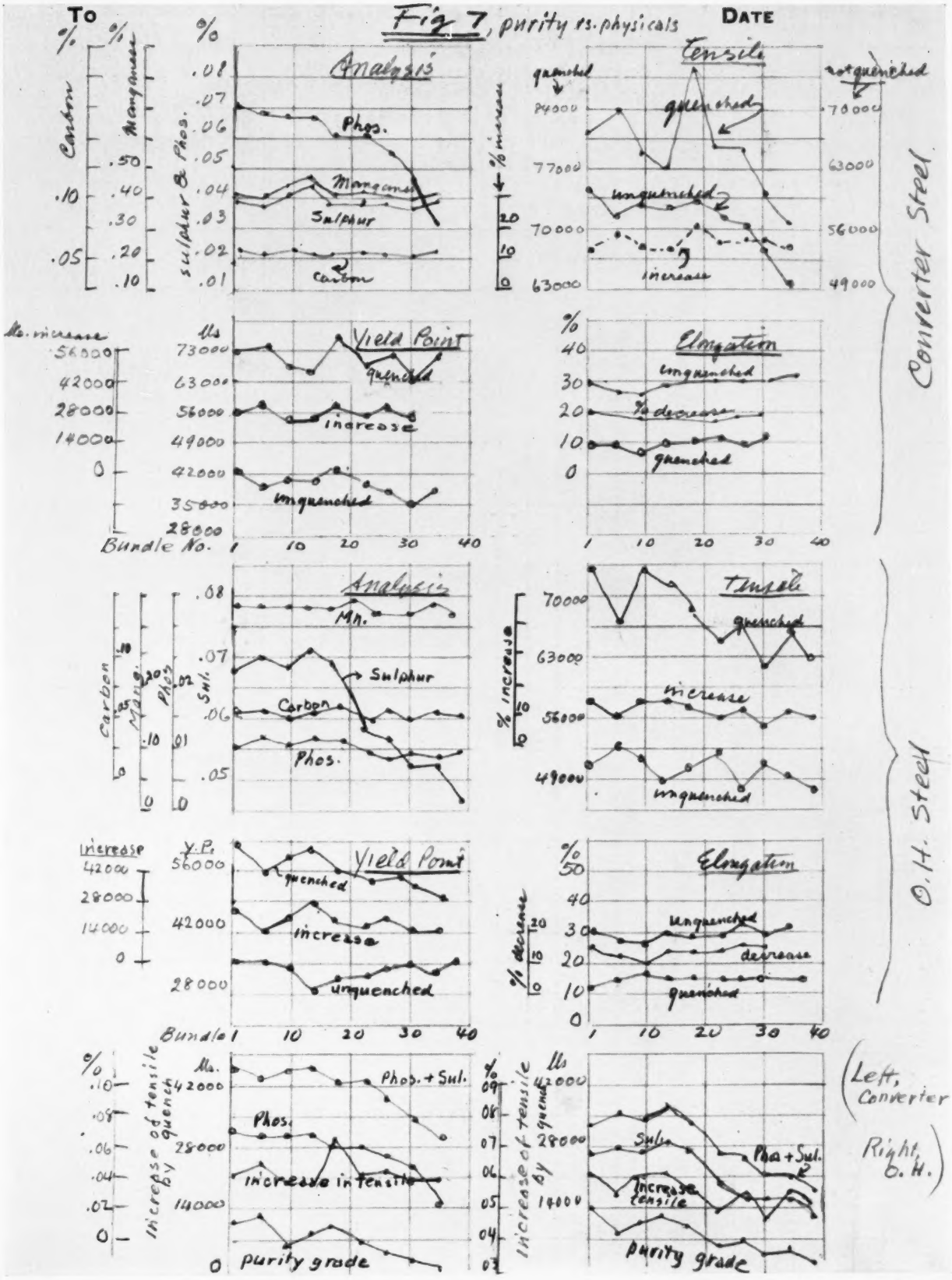


Fig 7, purity vs. physicals
TO
DATE
Analysis
Phos.
Manganese
Sulphur
Carbon
Tensile
quenched
unquenched
increase
Converter Steel
Yield Point
Elongation
Bundle No.
0.14. Steel
Left, Converter
Right, O.H.
Phos. + Sul.
increase in tensile
purity grade

Novel Gas Furnace Improves Bright Annealing

By J. B. Neally,
American Gas Association, New York, N. Y.

The subject of bright annealing is one of vital interest in the production of ferrous and non-ferrous alloy wires. An interesting heating application to improve the finish is shown herewith. ✦ ✦ ✦ ✦ ✦

WIRE drawing is essentially a process alternating between reduction and annealing, for drawing hardens the metal and heat must be resorted to for softening it. For many years much of our Fourdrinier wire, especially that of the phosphor bronze type, was imported from abroad. The sole reason for this was that there was no suitable equipment in this country for properly annealing this item. The problem was to obtain a uniform heat that could be controlled so as to produce definite grain sizes in the metal, at will. With the aid of gas fuel, the perfect anneal, in all its variations, is now accomplished in a new type furnace.

✦ ✦ ✦

FINE wires of brass, bronze, nickel, silver, monel and other non-ferrous metals and alloys are drawn by F. A. Harris, Inc., Springfield, Mass. Customers use this wire for making fine springs, resistance units in radios, for weaving into wire cloth for filters, or for the paper mills and so on.

✦ ✦ ✦

THE raw material used in this plant is ⅛ in. round wire stock and this is drawn down, in successive steps, to the finest sizes. During this process the frequency of the anneal varies with the type of wire being drawn. Tungsten carbide dies are used for the bigger sizes and diamond dies for the smaller. The machines are continuous with the number of drafts (on dies) varying from 10 to 22 in a single operation. Picking a sample customer specification at random as an indication of the kind of work done here, we find one calling for a phosphor bronze (tin 8%) wire, .0095 in. in diameter, tensile 73000 lbs. per sq. in. and yield point 56,000 lbs. per sq. in. with an elongation of 55-60%.

✦ ✦ ✦

Properly Controlled Heat Necessary

THE only way to make this wire is to properly process the preliminary operations such as breakdown, draw and anneal. Great care must be exercised in the final drawing operations to keep a uniform stress in draft and to see that the diamond dies are perfectly round and true so that the wire is not weakened by longitudinal lines or scratches. But above all things the annealing must be properly controlled and this calls for gas heat and strand, as against bulk, annealing.

✦ ✦ ✦

THE first furnace in this country in which wires of this type were correctly annealed was designed and built by F. A. Harris. With the accumulation of knowledge and experience through the years Mr. Harris designed better and better furnaces as time went on. Finally he has had built, for his new plant, the longest and most efficient strand annealing furnace in this country.

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MOST of the furnaces of this type are 10 to 12 ft. in length but this one is 18 ft. long. The chief advantage of a furnace of this length is that a perfect anneal can be obtained without forc-

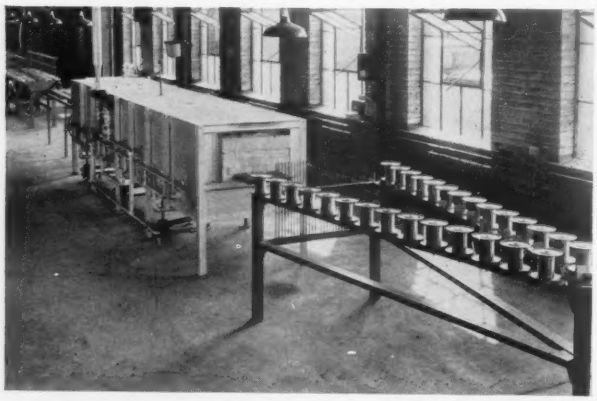

Fig. 1. Novel gas fired, strand (wire) annealing furnace which is automatic as to temperature control and continuous in operation. Individual strands of wire pass through iron pipes located in heating chamber. These pipes act as muffles in which prepared atmospheres are employed to insure bright annealing. ✦ ✦ ✦ ✦ ✦

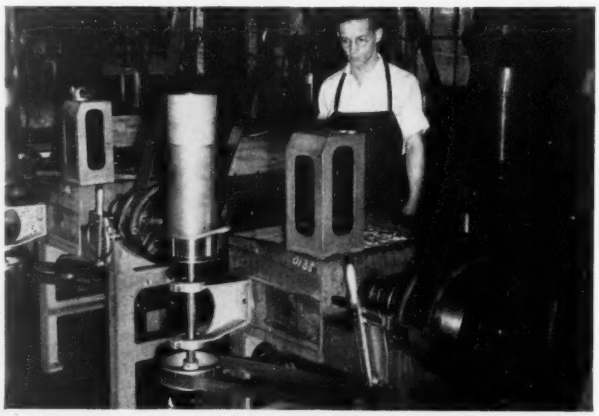

Fig. 2. Corner in fine wire drawing plant of F. A. Harris, Inc., showing some of the machines which are continuous with the number of drafts (or dies) varying from 10 to 22 in. in number. ✦ ✦

ing the heat. Forcing a shorter furnace, and this occasionally becomes necessary, means that a uniform grain structure throughout the length of the wire will not be obtained. An inferior product results which shows up in the performance of the product. Wire cloth, for instance, will develop weak spots and premature failure in service. On the other hand, there are limits to the length of furnace, for one much longer than 18 ft. might bring about variation in wire size, due to elongation of the wire caused by the greater tension necessary to pull it through at the required temperature.

✦ ✦ ✦

Iron Pipes for Separate Strands

THE heating chamber of this furnace is 25 in. wide and 14 in. high, from hearth to top of arch,—inside dimensions. It is surrounded by 9 in. of insulating refractory, and is held within a steel shell. This furnace will hold up to 120 lengths of ordinary iron pipe, of small size and a single strand of wire passes through each. The pipes protrude from the furnace at each end and a steel frame holds spools from which the wire is unwound at the charging end. A similar frame at the discharge end holds a similar number of reels on which the wires are wound as they are pulled through the furnace and pipes.

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BESIDES keeping the wires from tangling these pipes also serve as muffles in which prepared atmospheres are employed to insure bright annealing. Different types of atmospheres are used such as carbon dioxide, nitrogen, hydrogen and city gas, for different products. These atmospheres are introduced through manifolds of block castings, about 3 ft. from the discharge ends of the tubes. The tubes are cut at this point and their ends screwed into these manifolds with just enough separation to permit the flow of gases. Furnace temperatures range from 700 to 1650 deg. F. while the speeds at which the wires are pulled through vary from 50 to 600 ft. per minute. Heat is supplied by 52 gas burners, half on each side, which underfire the hearth. These gas burners are manifolded in three groups so that the furnace has three separately controllable temperature zones. The furnace sits on short legs to provide room for the gas and air supply mains below. The gas burners on both sides of each zone, are all manifolded to a single inspirator in the air line to which the gas line is connected after passing through a zero governor. A positive pressure blower supplies air to the three inspirators, at 20 oz. pressure. While all three zones are controllable, for most of the work, control of the center zone suffices. A thermocouple in the top center actuates a potentiometer type controller which operates an on and off solenoid valve in the air supply line to the center group of gas burners. This valve is by-passed to provide a low setting of the gas flames when the valve is in the off position.

✦ ✦ ✦

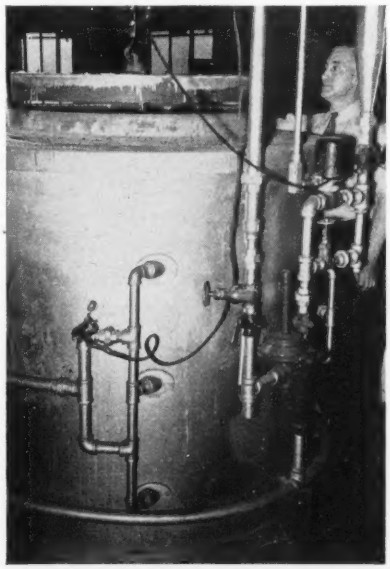

Fig. 3. Gas furnace for batch annealing wire. The internal construction of both this and the continuous furnace embodies a series of U-shaped tray sections with tapering tunnels which intensify the entrainment of the furnace atmosphere with the newly burned gases. Removable tyre blocks and a supplementary bottom are also employed.

Novel Gas Furnace Construction

THIS furnace is also unique in its internal construction which embodies a series of U-shape tray sections of unusual strength and wear resisting qualities. While no flame comes in contact with the work the chamber containing the work is entirely filled with the products of combustion, which prevents any free air from reaching the work (in this case, pipes). These U-shape sections have tapering tunnels which intensify the entrainment of the furnace atmosphere with the newly burned gases, reducing the temperature in this combustion chamber and this prevents burned firing chambers and burner ports. Removable tyre blocks and a supplementary bottom are something entirely new in furnace construction. The tyres or burner ports, are individual sections corresponding to the tray stop. The holes are molded in the brick rather than drilled, since a kiln dried surface will last longer than a tool cut surface. The supplementary bottom of 1⅛ in. firebrick extends under the whole tray and facilitates replacements by protecting the actual bottom of the furnace, keeping it a smooth and level surface on which to assemble the new tray.

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OTHER type furnaces were discarded for this work because they developed hot spots, among other things, which reduced their capacity and efficiency. The hot spot would usually develop in the center leaving the ends comparatively cold. For instance a 3 ft. hot spot would reduce the effective working length of a 10 ft. furnace by half or more. Oil was tried and abandoned because of inability to control temperatures and obtain uniformity in heating. Furthermore pipes of expensive alloy are necessary with electric and oil furnaces as ordinary iron or steel pipe scales quickly and is eaten through quite rapidly.

✦ ✦ ✦

Gas Furnace for Batch Annealing

THERE is another gas furnace in this plant used for batch wire annealing. This was erected by the same firm that built the continuous furnace and the same type of construction was employed. Circular in shape, the furnace pre-heating chamber is 33 in. in

(*Please turn to Page 379*)

Outstanding Personalities of the Wire Industry

E. J. P. Fisher Appointed Assistant Manager, Tube Mill and Cold Drawing Division of the Aetna-Standard Engineering Company of Youngstown, Ohio

MR. E. J. P. FISHER, formerly metallurgist with Republic Steel Corporation, Chicago, has been appointed assistant manager, tube mill and cold drawing division of the Aetna-Standard Engineering Company.

✦ ✦ ✦

MR. Fisher is well-known to members of the Wire Association through having received the first medal award of the Association in 1934 for his paper entitled "Cold Drawn Steel Spring Wire." At that time he was metallurgist for the Keystone Steel & Wire Company, Peoria, Illinois.

✦ ✦ ✦

HE was born of American parents in Berlin, Germany, in December, 1900. Received B. S. Degree in chemistry, Worcester Polytechnic Institute, in 1921. Pursued post-graduate studies in Metallurgy at the School of Mines, Columbia University in 1921. From 1922 to 1929 his early metallurgical career was quite varied and included connections with General Electric Company, R. Wallace and Sons Manufacturing Company, Carpenter Steel Company and the Diamond Chain and Manufacturing Company. In November, 1929 he began his connection as Physical Metallurgist with Keystone Steel & Wire Company and was in charge of the Metallographic and Physical Testing Departments and directed high carbon wire research and development especially. He is a member of the American Society for Metals, the American Institute of Mining and Metallurgical Engineers, the American Society for Testing Materials, the Wire Association, the American Petroleum Institute and the Peoria Academy of Science.

✦ ✦ ✦

J. W. Wagoner

J. W. WAGONER, formerly general manager, Salem Engineering Co., Salem, O., has been appointed vice president in charge of all operations, both sales and production.

E. J. P. FISHER

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Rollo E. Falk Elected Director of Revere Copper & Brass, Inc.

AT the annual meeting of Revere Copper & Brass, Inc., Rollo E. Falk, vice-president and general manufacturing manager, was elected a director of the company.

✦ ✦ ✦

MR. FALK has been manufacturing manager for Revere since 1932, and previously was works manager of the Dallas Division, in Chicago, Ill.

✦ ✦ ✦

MR. FALK'S headquarters are in New York.

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John J. Sullivan Superintendent Cold Drawn Department, Canadian Atlas Steels, Ltd., Welland, Ontario, Canada

RECENTLY John J. Sullivan was appointed superintendent, Cold Drawn department of Canadian Atlas Steels, Ltd., Welland, Ontario, Canada.

✦ ✦ ✦

MR. SULLIVAN has been in the wire business for thirty years as wire drawer, die setter, gauger, foreman and superintendent, having been in the employ of the following companies: Wright Wire Company and American Steel & Wire Company, Worcester, Mass.; Wickwire Spencer Steel Corporation, Worcester, Mass. and Buffalo, N. Y.; American Steel Company, Ellwood City, Pa.

✦ ✦ ✦

AT the time of his employment by the Canadian Atlas Steels, Ltd., he was assistant wire mill superintendent of the Townsend Company, New Brighton, Pa.

✦ ✦ ✦

Richard C. Lewis

RICHARD C. LEWIS, sales engineer of Farrel-Birmingham Company, Inc., Ansonia, Conn., was killed in the accident to the United Airlines plane which crashed at 10:20 P. M., May 24, 1938, just before reaching its destination, the Cleveland airport.

✦ ✦ ✦

AT the time of his death Mr. Lewis was manager of the rolling mill sales division of the Farrel-Birmingham Company in charge of sales of rolling mill equipment and roll grinding machines.

✦ ✦ ✦

HE was widely known throughout the steel and non-ferrous rolling mill industries as an experienced and capable engineer with a thorough knowledge of the design and operation of rolling mill equipment. He was highly esteemed for his personal qualities as well as for his professional ability by all of his associates and his many friends in the trade, and his passing is deeply regretted.

✦ ✦ ✦

W. C. Davis, Vice President, Simplex Wire & Cable Co.

W. C. DAVIS, for 41 years associated with the Simplex Wire & Cable Co., Cambridge, Mass., has been made vice president. He is succeeded in his former post as sales manager by G. L. Roberts, assistant sales manager since 1927. G. A. Grauer becomes assistant sales manager.

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in April, 1938 and April, 1937
(In gross tons)

	APRIL 1938	MARCH 1938	APRIL 1937
Wire rods	2,829	5,377	6,508
Strip steel	3,400	5,005	18,677
Plain, black or galvanized iron or steel wire	4,045	2,560	3,952
Barbed wire and woven wire fencing	2,583	1,706	3,401
Woven wire screen cloth	99	80	199
Wire rope	359	446	480
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	414	451	845
Wire nails	1,354	1,408	2,096
Tacks	21	27	21
Other nails, including staples	390	245	204
Bolts, machine screws, nuts, rivets and washers	671	806	1,005
Total, these 11 classifications	16,165	18,111	38,388

Imports of Iron and Steel Wire into the United States
(In gross tons)

Concrete reinforcement bars	38	23	586
Hollow bar and drill steel	76	92	254
Wire rods	271	369	1,751
Barbed wire	554	538	1,746
Round iron and steel wire	98	96	581
Telephone and telegraph wire	.....	3	.....
Flat wire and strip steel	188	247	300
Wire rope and strand	185	228	396
Other wire	86	82	252
Hoops and bands	1,579	724	3,426
Nails, tacks and staples	561	365	2,686
Bolts, nuts and rivets	17	13	23
Total, these 12 classifications	3,653	2,780	12,001

Exports of Insulated Wire and Cable, April, 1938

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber covered wire	529,490	$131,026	89,588	$18,246
Weatherproof wire	197,461	27,782	109,042	17,280
Other insulated copper wire	427,889	193,398	145,041	29,139
Nickel-chrome electric resistance wire	26,795	37,467	323	1,076
Total, these four classifications	1,181,635	$389,673	343,994	$65,741

EXPORTS of iron and steel products (excluding scrap) from the United States in April amounted to 179,250 gross tons valued at $12,061,586 in comparison with 188,235 tons valued at $13,991,641 in March, and 255,704 tons valued at $15,855,175 in April 1937. April imports of these same products registered a substantial increase to 21,225 tons valued at $1,140,875, after having recorded a very sharp decline since January. These totals compared with receipts of 11,600 tons valued at $990,379 in March, and 56,484 tons valued at $2,709,526 in April of last year.

✦ ✦ ✦

AN outstanding feature of the month's trade was the sharp advance in pig iron shipments to 44,362 tons from 22,519 tons in March; however, steel ingot exports decreased to 7,774 tons from 23,021 tons. That European producers are catching up with local requirements or that iron and steel consumption in their respective markets has declined is demonstrated by the more normal volume of American exports to Continental and British outlets in April, as well as in the preceding month. Reports have been received here which show that since the early months of the current year many European steel mills have been able to catch up on backlogs because of the diminishing volume of current business being received. Then, too, the European raw material situation has become easier.

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THE leading product exported on a tonnage basis in April was pig iron totaling 44,362 tons in comparison with 22,519 tons in March and 38,177 tons in April, 1937. The bulk went to Japan which took 41,574 tons, with France next in importance with 2,116 tons. Tin plate ranked next with a 17,972-ton trade against 15,201 tons and 30,289 tons and went chiefly to Spain 5,514 tons, Japan 4,067 tons, Canada 2,004 tons, and the Netherlands 1,099 tons.

✦ ✦ ✦

THIRD in importance was plate, exports of which amounted to 23,892 tons against 18,962 tons and 31,529 tons, and the principal outlets were Kwantung 8,408 tons, Canada 2,652 tons, the Netherlands 2,233 tons, the Union of South Africa 2,114 tons, Sweden 1,494 tons, and Mozambique 1,270 tons. Then came black steel sheets with 14,419 tons against 20,963 tons and 29,327 tons going mostly to the Soviet Union 3,807 tons, Canada 3,802 tons, Australia 1,691 tons, and Brazil 923 tons.

✦ ✦ ✦

STEEL bar exports totaled 12,445 tons against 15,496 tons and 12,689 tons, and the most prominent markets were Japan 2,282 tons, Hong Kong 1,535 tons, the Philippine Islands 1,298 tons, and Canada 1,178 tons. Then came exports of pipe which amounted to 8,707 tons against 12,193 tons and 11,219 tons going mainly to Colombia 2,902 tons, Canada 1,173 tons, and Venezuela 1,026 tons.

✦ ✦ ✦

JAPAN was the chief individual market in April and accounted for 53,723 tons against 47,247 tons in March and 55,495 tons in April, 1937. The predominating items shipped to this destination were pig iron 41,574 tons, tin plate 4,067 tons, steel bars 2,282 tons, wire rods 2,146 tons, and ingots 1,753 tons. Canada ranked next with 23,290 tons against 21,295 tons and 61,362 tons of principally black steel sheets 3,802 tons, plate 2,652 tons, skelp 2,650 tons, strip steel 2,256 tons, shapes 2,064 tons, tin plate 2,004 tons, ingots 1,435 tons, and steel bars 1,178 tons.

(*Please turn to Page 364*)

Exports and Imports

(*Continued from Page 363*)

EXPORTS to Kwantung amounted to 11,857 tons against 10,253 tons and 2,818 tons and consisted of principally plate 8,408 tons, and rails 1,990 tons. The Netherlands took 7,148 tons against 3,091 tons and 3,637 tons and in this trade ingots 2,618 tons, plate 2,233 tons, and tin plate 1,499 tons, were outstanding.

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THE Colombian market accounted for 6,663 tons of the April trade against 5,114 tons and 3,081 tons and the chief products were pipe 2,902 tons, plate 2,333 tons, and tin plate 1,099 tons. Brazil took 6,066 tons against 5,507 tons and 5,093 tons of chiefly rails 1,494 tons, black steel sheets 923 tons, tin plate 794 tons, and barbed wire 402 tons.

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Imports

AFTER recording very sharp declines since January of the current year, April imports of semifinished and finished iron and steel products registered a substantial increase—to 21,225 gross tons valued at $1,140,875. These totals compared with receipts of 11,600 tons valued at $990,379 in March and 56,484 tons valued at $2,709,526 in April of last year.

✦ ✦ ✦

THE April import trade was 9,625 tons higher than the March volume and four products—pig iron, spiegeleisen, shapes, and sheets—accounted for 9,537 tons of this increase. The outstanding gain (3,077 tons) was that registered in pig iron imports, followed by spiegeleisen (3,004 tons), shapes (2,350 tons), and sheets (1,106 tons).

✦ ✦ ✦

ON a tonnage basis, the leading item received in April was structural shapes whose total of 4,473 tons compared with 2,123 tons in March and 10,716 tons in April, 1937, and came from chiefly Belgium 3,125 tons, and France 1,314 tons. Pig iron followed with 3,823 tons against 746 tons and 11,469 tons, respectively, and was had from principally Norway 2,988 tons and British India 500 tons. Third-ranking was spiegeleisen whose 3,204 tons compared with 200 tons and 1,240 tons and was supplied entirely by Canada.

✦ ✦ ✦

NEXT in importance were sheets with receipts at 2,121 tons against 1,015 tons and 1,063 tons—the outstanding countries of supply being Germany 1,434 tons and Belgium 683 tons. Following were hoops and bands with 1,579 tons against 724 tons and 3,426 tons, coming from Belgium 960 tons, France 446 tons, and Germany 173 tons. Steel bars were next with 1,500 tons against 1,232 tons and 7,145 tons, and were supplied by mostly Belgium 645 tons, France 411 tons, and Sweden 216 tons.

✦ ✦ ✦

BELGIUM continued in April to be the leading import source, and accounted for 6,624 tons in

MICROMETER PRECISION — MICRO-WELD — ELECTRIC WELDING

A complete portable unit machine for general purpose Butt Welding, instantly adjustable for various sizes of wire and perfectly adaptable for all wire manufacturing and fabricating requirements.

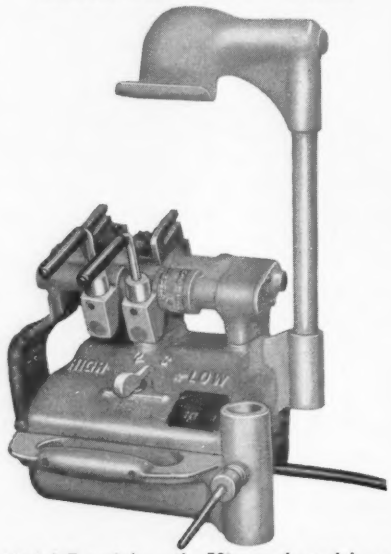
✦ ✦ ✦

THIS Welder is provided with a specially designed, sensitive limit switch, operating automatically with consistently uniform results on even the smallest sizes of wire, where reduced upset spring pressure is necessary. Tungsten contact tips are used in this switch to eliminate the maintenance and adjustment ordinarily required on copper contacts, which are customarily used for this service. By using the best material available in this equipment, positive, accurate results are secured under all conditions.

✦ ✦ ✦

Your inquiries are solicited.

MODEL "E"
MICRO-WELD BUTT WELDER



Model E weighs only 50 pounds and is so simply designed that anyone can weld wires from No. 4 to No. 20 gauge with it—instantly changing from one gauge to another.

EVERY working part of the machine is enclosed and protected from dirt and corrosion from acid fumes. The only servicing that is necessary, is an occasional brushing of the dies with the wire brush which comes with the machine, and an occasional oiling with Three-In-One oil in the four oil holes which are visible on the index barrel and slides.

✦ ✦ ✦

HIGH electrical efficiency, with only 2½ KW rating at full capacity, allows light socket operation, which further increases the general utility of this adaptable Welder.

✦ ✦ ✦

FOR especially rugged service or for traveling crane mounting, this machine is also available made from high strength bronze, at no additional increase in price.

✦ ✦ ✦

Your inquiries are solicited.

MICRO PRODUCTS COMPANY — MICRO-WELD — 20 N. WACKER DRIVE • CHICAGO

comparison with 4,492 tons in the preceding month and 15,509 tons in the corresponding one of 1937. The outstanding products in this trade were shapes 3,125 tons, hoops and bands 960 tons, and sheets 683 tons. Canada was next with 3,598 tons and in this trade the principal product was spiegeleisen 3,204 tons. Norway followed with 3,267 tons against 1,080 tons and 3,392 tons and here pig iron (2,988 tons), and ferromanganese (259 tons) were outstanding. Germany accounted for 3,003 tons against 2,369 tons and 10,129 tons, and the principal items were sheets 1,434 tons, barbed wire 336 tons, castings and forgings 178 tons, and nails, tacks, and staples 175 tons. France followed with 2,273 tons against 821 tons and 4,600 tons, and the predominating products were shapes 1,314 tons, ferromanganese 562 tons, hoops 446 tons, and steel bars 411 tons.

✦ ✦ ✦

CARD CLOTHING receipts totaled 7,970 square feet valued at $14,397 against 19,301 square feet valued at $34,918 and came entirely from the United Kingdom (7,566 square feet valued at $13,380), Germany (255 square feet valued at $815), and Belgium (149 square feet valued at $203).

✦ ✦ ✦

RECEIPTS of WIRE HEDDLES totaled 1,054,000 pieces against 256,000 pieces and were supplied by Japan 654,000 pieces, and Germany 400,000 pieces.

✦ ✦ ✦

A TRADE of 52,623 square feet resulted in WIRE CLOTH AND SCREEN against 28,932 square feet in March, and the bulk came from Germany 24,191 square feet, the Netherlands 18,111 square feet, and Canada 9,775 square feet.

✦ ✦ ✦

RECEIPTS of WIRE FENCING AND NETTING, galvanized before weaving, amounted to 429,250 square feet against 575,250 square feet and came from Germany 329,250 square feet, and the Netherlands 100,000 square feet. Of that galvanized after weaving, the total was 643,500 square feet against 505,200 square feet and this amount came from the Netherlands 624,000 square feet, and the United Kingdom 19,500 square feet.

✦ ✦ ✦

FOURDRINIER AND OTHER PAPER-MAKING WIRE imports at 16,311 square feet compared with 26,703 square feet and were supplied by Germany 12,281 square feet, France 2,230 square feet, and Sweden 1,800 square feet.

✦ ✦ ✦

EXPORTS of iron and steel wood screws during April, 1938 totaled 16,241 gross valued at $2,704. Of this total Union of South Africa took 5,500 gross valued at $512; Cuba 2,535 gross valued at $560; Colombia 2,345 gross valued at $313; Canada 725 gross valued at $149; United Kingdom 665 gross valued at $71; Netherlands 552 gross valued at $100.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 1,785 gross valued at $1,093. Of this total Venezuela took 386 gross valued at $224; Panama 326 gross valued at $264; Cuba 285 gross valued at $104; Canada 223 gross

(*Please turn to Page 380*)

Unique architectural forms at the 1939 New York World's Fair Site dramatize modernism and the World of Tomorrow

INCREASE PRODUCTION — AND PROFITS

Torrington new high speed, Timken bearing equipped spring coiling machines have established a new era in high speed production of coil springs — are modern — pre-eminent in their field — include patented features and improvements of great significance to spring makers. A new bulletin describes in detail Torrington Spring Making equipment — MACHINES WHICH ARE REVOLUTIONIZING PRESENT-DAY SPRING PRODUCTION. Write TODAY.

Spring Making Machines by

TORRINGTON

THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT • • • U. S. A.

Hot-Dip Galvanizing Practice

A NEW book by W. H. Spowers, Jr., on the above subject has been published by the Penton Publishing Company, Cleveland, Ohio.

✦ ✦ ✦

IT has been almost twenty years since a satisfactory book on galvanizing practice has been published for the industry. This book by Mr. Spowers comes from a man who has been a consultant in galvanizing practice for many years, and who is thoroughly qualified to produce a volume to satisfy the needs of those who have to do with the art of coating steel with zinc.

✦ ✦ ✦

IN the foreword to the book, which was, incidentally, written by Mr. Spowers' son, Gale McComb Spowers, the personal background of the author and his background in galvanizing work, dating back over seventy years, through three generations, is presented in a most interesting manner and it is quite apparent that the author possesses a very complete experience with the various practices which he discusses in his book.

✦ ✦ ✦

PROBLEMS of galvanizing are expressed in simple style, and in 23 chapters the principles followed in zinc coating, fluxing, dross recovery, and kettle design are given fully. There are also descriptions of how to galvanize wire, poultry netting and hardware, cloth, pipe, sheets, pipe fittings, stamped metal ware, range boilers and barrels, etc. The presentation is concluded with a discussion of pyrometry in hot galvanizing. There is also a 61-page bibliography of references to zinc coating of a general and miscellaneous character, information as to the history and development of galvanizing, galvanizing procedure, equipment and fuels, effect of galvanizing, tests of coatings, specifications, galvanizing plants, by-products and their recovery, as well as a complete list of the United States and British patents dealing with galvanizing.

✦ ✦ ✦

THE book is well illustrated, and the author presents eight 6 x 28-inch drawings of furnace settings, layouts, asbestos wipes, etc., inserted in the pocket on the inside of the back cover for the convenience of the reader.

✦ ✦ ✦

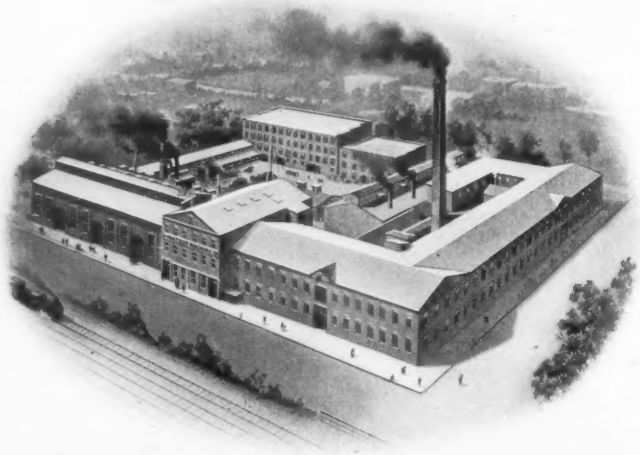
IT is a pleasure to find such a complete and authoritative work on this subject, and the arrangers of the book, as well as the author, should be complimented upon the thoroughness with which the indexing and cross-references work has been done.

THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ENGINEERS



MACHINISTS

MANUFACTURERS OF

ELECTRICAL WIRE & CABLE, WIRE ROPE, CORDAGE & GENERAL MACHINERY

YOUR INQUIRIES ARE INVITED

'Round the World With the Wire Industry

German Notes

THERE will apparently be no further standardization of wire products, as concerns wire ropes and wire mesh. The Austrian industries (except such as are working exclusively for export) have now adopted the German standards. Efforts to sell standardized wire products for export have been abandoned some time ago, as it was plain that each market would continue to buy only its own standards and not the international ones. Even in Latin America this attempt has failed, though there are so many standards taken over from Europe (for ex. machinery standards) in this continent.

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JAPANESE wire competition shows a revival, particularly in the Dutch Indies, Siam and the Straits Settlements. Japanese prices however are only slightly below continental prices.

✦ ✦ ✦

THE needle export business (except in machine needles) is going down. Here there is no Japanese competition except in the very cheap qualities. In wire chains, particularly meter chains, business is satisfactory and prices well maintained.

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EFFORTS to eliminate different systems of gauges on the export markets for wire products is not yet effected. The Jauge de Paris as well as the various American systems (for ex. Brown & Sharpe) and even the old "Westfalian wire gauge" still exist though the Standards wire Gauge (SWG) is dominating the field. Nevertheless there are still enough customers who buy in BWG (Birmingham wire gauge) sizes which very often causes discrepancies. The old Westfalian wire gauge is wholly different from all other systems and is specified still in Syria, Palestine and Turkey, whereas the French Jauge de Paris is in favour in the French Colonies, Morocco and also in Syria, Irak, Iran and very often in the Balkan countries. The American wire gauge is specified in the Philippines and many Latin American markets. Manufacturers have been warned recently to be very careful in looking through order books, as due to the different systems of gauges there often rises difficulties with the customers.

✦ ✦ ✦

AS reports the IWECO the general business situation on the wire export market continues to show signs of the improvement started the end of April. Though there are some markets buying little, business with most of the

THE MACHINES THAT PUT THE "RINGS" IN SPRINGS

DESIGNERS AND MANUFACTURERS
OF EQUIPMENT FOR
THE WIRE MILLS AND SPRING MAKERS

UNIVERSAL SPRING COILERS
TORSION SPRING MACHINES
FLEXIBLE CASING AND
FLEXIBLE METALLIC TUBE COILERS
STRAIGHTENING AND BUNDLING MACHINES
RING COILING MACHINES FOR BRAZING
KEY RINGING MACHINES
COLD ROLLING EQUIPMENT FOR WIRE
SPECIAL MACHINERY OF ALL TYPES

YOUR INQUIRIES INVITED

SLEEPER & HARTLEY, Inc.
WORCESTER — MASSACHUSETTS

'Round the World With the Wire Industry

Latin American markets, the Far East and particularly the Near East (this in the first place) is rather satisfactory. The circumstance that a great number of rush orders have been received, shows that stocks are down. As concerns export prices there is no change to be noted except for export to Holland, Sweden and Roumania. Outsider competition continues but on the whole the amount of business booked by the outsiders is not important, whereas American competition is felt in barbed wire. In all other wire products the American prices continue to be about equal to those of the IWECO except in Argentine and Brazil, where the competition is continuing. Considerable orders for wire were placed in Europe by Mexico, which is unusual. Apparently one expects these purchases (together with others) to influence the oil conflict solution.

✦ ✦ ✦

Bruntons' Entertains Employees

ON June 4th the directors of Bruntons (Musselburgh) Ltd., steel wire manufacturers of Musselburgh, Scotland, entertained over 1200 of their employees as their guests at an outing to the Empire Exposition at Glasgow, Scotland.

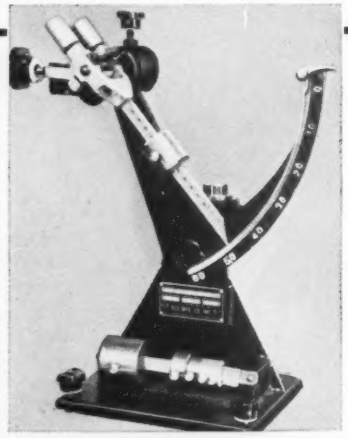
✦ ✦ ✦

THE invitation to the employees included return railroad tickets, admission to the exposition, high tea and three shillings to each employee to cover personal expenses. In addition, Bruntons' issued a very handsome souvenier program to commemorate the occasion, a copy of which was presented to each of those attending.

Compulsory Acceptance of a Draft in France

MANY firms buying goods on credit, make it a principle not to accept a draft drawn against them, thus throwing the burden of financing wholly on the seller. Hereafter, if delivery is accepted of goods sold on credit, the buyer MUST accept a covering draft whether he wants to or not. This measure, one of the most important of the decree laws in point of its effect on business practices, is part of the government's policy to increase the use of commercial paper in France and will be followed by other measures to increase the use of cheques and similar instruments of payment.

✦ ✦ ✦



- Highly portable—weighs only 17 lbs. Easily set up any place.
- Tests straight or curved wire, hard or soft from .015" to 0.100".
- Tests strips up to ⅜" wide by .050" thick.
- Measures stiffness and resistance to bend from 0 to 60 degrees.

Net Price $150.00 — F. O. B. Harrison, N. J.

Rapid . . . Rugged . . . Sensitive!

NEW RCA WIRE STIFFNESS TESTER

For many years, there has been a need for a uniform method for testing the stiffness of wire—a property of growing importance to wire users. The RCA Wire Stiffness Tester fills this need in a simple and fully satisfactory manner. It is highly accurate, comes in a wide range of sizes and is quickly and easily set up on any reasonably level table or bench.

In principle, the RCA Wire Stiffness Tester applies a load to the specimen which is supported on a cantilever beam and bends it through an angle. The amount of load is adjustable and the degree of bend is the measure of stiffness, easily read from the scale.

Complete information available on request. Ask for booklet

TUBE PARTS and MACHINERY DIVISION

RCA Manufacturing Company, Inc., Harrison, N. J.

A Review of Recent Wire Patents

No. 2,116,169, WIRE BENDING MACHINE, Patented May 3, 1938 by Harry R. Geer, deceased, late of Westmount, Pa., by Eula S. Geer, administratrix, Viewmont, Pa., assignor to Bethlehem Steel Company, a corporation of Pennsylvania.

In the manufacture of wire articles, such as reel members for forming reels or spools of the collapsible type upon which barbed or other forms of wire is wound, mechanism is provided to control the feed of wire to the machine; for operating the crank arms to form loops of the reel members; for operating bending dies to form recesses in the reel members and bottom twisters for bending the looped ends of the reel member laterally; for cutting the feed wire into lengths and forming hooked ends simultaneously; and for adjusting the die plates and loop formers so that reels of different sizes may be produced. The machine may run continuously or intermittently and is provided with trip means to stop the operation after a predetermined number of reel members have been formed. There is also provided kinking mechanism for bending the looped ends of the reel members to the desired angle, and means automatically ejecting the formed reel members from the machine.

✦ ✦ ✦

No. 2,116,267, CONDUCTOR WITH AIR SPACE INSULATION, Patented May 3, 1938 by Franz Klimmer, Berlin-Oberschoneweide, Germany, assignor to Felton & Guilleaume Carlswerk Actien-Gesellschaft, Cologne-Mulheim, Germany.

For the transmission of high frequencies, a co-axial conductor is provided wherein the axial conductor is separated from the surrounding conductor by a self-sustaining hollow open helix of an insulating material such as polystyrol.

✦ ✦ ✦

No. 2,116,268, HIGH FREQUENCY CONDUCTOR, Patented May 3, 1938 by Franz Klimmer, Berlin-Oberschoneweide, Germany, assignor to Felten & Guilleaume Carlswerk Actien-Gesellschaft, Cologne-Mulheim, Germany.

A plurality of conductors are twisted together, polystyrol threads being wound helically around the individual conductors, with polystyrol helics in the worming spaces between the conductors, and bands of polystyrol are laid around the conductors and helices. Over the bands are wound polystyrol helices which are covered with an outer sheath.

✦ ✦ ✦

No. 2,116,327, MACHINE FOR TEMPERING SPRINGS, Patented May 3, 1938 by Charles R. Simmons, Chicago, assignor to Nachman Spring-Filled Corporation, Chicago, Ill., a corporation of Illinois.

Springs are delivered at regular intervals from a source of supply and carriers are arranged to cause the springs to be subjected successively to the action of an electric heating current and then to chilling means.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

No. 2,116,402, SEAT CONSTRUCTION, Patented May 3, 1938 by Clarence H. Menge, Detroit, Mich., assignor to The Murray Corporation of America, a corporation of Delaware.

Springs of the type disclosed in the Kaden patent 2,002,399 and formed by bending a section of wire into a series of coplanar adjacent convolutions, are utilized to form a cushion in which the springs constitute the surface structure for the cushion and also the resilient spacing means for the frames.

✦ ✦ ✦

No. 2,116,588, BEDSPRING, Patented May 10, 1938 by Don Carlos Travis, Kenosha, Wis., assignor to Simmons Company, New York, N. Y., a corporation of Delaware.

Flexible longitudinal and transverse straps are disposed over the vertical coilsprings and are interwoven at their

(Please turn to Page 370)

DRY BLANKETS FOR METAL BATHS
GRAY'S FIREPROOFED CARBONS
PREVENT OXIDATION
SAVE HEAT

FIRST G-B 412

For Galvanizing and Tinning

Recommended for temperatures up to 900° F.

NOW A-B 24

For lead annealing, and other high temperature operations.

Will not cake, melt or fuse

Burns slowly at high temperature

Low cost

Write for further information

GRAY CHEMICAL COMPANY ROULETTE, PA. (Potter County) Phone Roulette 2131

FORTY YEARS OF SUCCESSFUL SERVICE

Vascoloy-Ramet Adds To Its Sales Engineering Staff

MR. GEORGE M. MENCKE, formerly with Thomas Prosser & Sons and later with the Carboloy Company, is now Sales Manager.

✦ ✦ ✦

MR. JAMES A. FRASER, formerly with Vanadium-Alloys Steel Company at North Chicago, is now Assistant Sales Manager.

MR. WALTER J. DENNIS, formerly with Illinois Tool Works, is now Die Sales Engineer in the Western territory, with headquarters at Chicago.

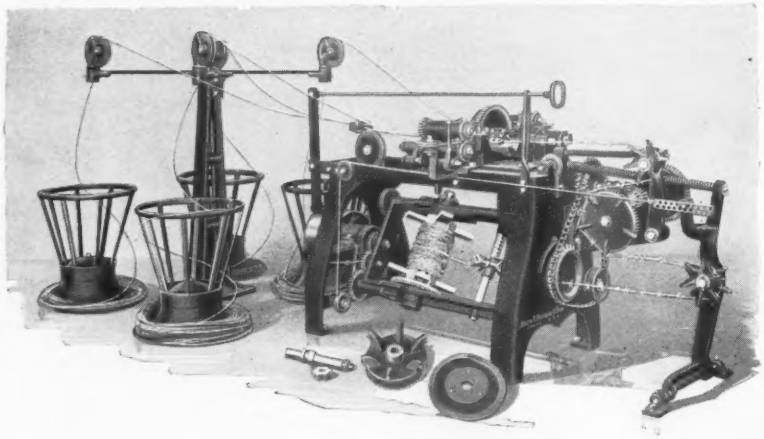
✦ ✦ ✦

MR. M. W. DENNIS, JR., formerly with Vanadium-Alloys Steel Company, is now Die Sales Engineer in the Eastern territory, with headquarters at Pittsburgh.

✦ ✦ ✦

MR. S. A. MINIEA is now Sales Engineer in the Chicago territory.

Glader Barbed Wire Machine



The GLADER Barb Wire machine is used throughout the world for the production of Barb Wire of any type or style of 2-point or 4-point wire, made from round wire.

The machines are furnished to make 2-point or 4-point wire, and with the necessary extra parts, can be arranged to make both 2-point and 4-point wire on the one machine.

The GLADER machine is very compact in construction and the main chain of gearing that drives the barb coiling mechanism is of cast-steel with machine cut teeth.

WM. GLADER MACHINE WORKS

210 No. Racine Ave. **Chicago, Ill., U. S. A.**

A Review of Recent Wire Patents

(Continued from Page 369)

zones of intersection by depressing portions of the longitudinal straps to form eyes for the accommodation of the transverse straps.

✦ ✦ ✦

No. 2,116,589, WIRE-BOUND BOOK INCLUDING SHEET-BINDING MEANS AND BLANKS THEREFOR, Patented May 10, 1938 by Emory A. Trussell, Milwaukee, Wis., assignor to Trussell Manufacturing Company, Poughkeepsie, N. Y., a corporation of New York.

The sheets of a book are provided with a wire binder bent to permit thrusting of portions thereof through perforations in the margins of the sheets, after which the binder is further bent to a form such as will preclude accidental separation of the sheets from the binder.

✦ ✦ ✦

No. 2,116,796, SPRING ASSEMBLY, Patented May 10, 1938 by David L. Levine, Lynn, Mass., assignor to Lisson & Mellen Company, Lynn, Mass., a corporation.

Arranged in rows are springs which are secured in location by tie wires which pass between corresponding pairs of springs throughout the length of the assembly and which are fastened to the terminal coils by junctions which are a part of the tie wire and which are so arranged as to allow flexing but do not work loose.

✦ ✦ ✦

No. 2,116,811, WOVEN WIRE BELT AND METHOD OF MAKING THE SAME, Patented May 10, 1938 by Nelson W. Webb, Belleville, N. J., assignor to Eastwood-Nealley Corporation, Belleville, N. J., a corporation of New Jersey.

Woven wire belts for Fourdrinier machines are joined by means of a brazed or soldered seam utilizing a rectangular strip of non-fusible metal against opposite sides of which the edges to be joined are butted and then coated with fusible metal.

✦ ✦ ✦

No. 2,118,168, METHOD OF TREATING RODS AND WIRE, Patented May 24, 1938 by Robert E. Cramer, Pittsburgh, Pa.

An oven is provided to receive several trucks loaded with rods or wire, previously pickled and lime-coated, and having a steam coil and fan arranged to recirculate the air from the oven over the coil and through the oven chamber, thus filling the whole chamber with high temperature air to thoroughly bake and dry the rods or wire in a minimum of time.

✦ ✦ ✦

No. 2,118,187, STRAND FORMER FOR PARALLEL WIRE CABLES, Patented May 24, 1938 by David S. Fine, New York, N. Y.

In spinning parallel wire suspension cables, a saddle is provided to receive and support the tubular strand formers which are secured together to form units containing varying quantities of strand formers, and are each provided with a

longitudinally directed aperture in the wall thereof.

✦ ✦ ✦

No. 2,118,297, FLEXIBLE MATTRESS SPRING STRUCTURE, Patented May 24, 1938 by John A. Douglas, Trenton, N. J., assignor to Trenton Spring Products Company, Trenton, N. J., a corporation.

The structure comprises a plurality of parallel coil springs forming longitudinal and transverse rows, the adjacent transverse rows being tied by elongate helices, and the edge rows being provided with semi-flexible upper and lower border frames comprising articulated sections and elongate helices securing the sections to the coil springs of the edge rows.

✦ ✦ ✦

No. 2,118,584, FLUID IMPREGNATED ELECTRIC CABLE, Patented May 24, 1938 by Frank L. Aime, New York, N. Y., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

The sheath for the fluid impregnated cable comprises a strip of metal wound helically into a tubular structure, the adjacent edges being interlockingly engaged and soldered and the center section of the strip being shaped to form a helical channel overlying a substantial portion of the width of the strip.

✦ ✦ ✦

No. 2,118,629. ELECTRIC CABLE, Patented May 24, 1938 by Richard C. Waldron, Clifton, N. J., assignor to The Okonite Company, Passaic, N. J., a corporation of New Jersey.

The construction provides a conductor which will stretch and contract with the cable without deformation. About a pliable core is applied a conductor composed of helical copper strands in a predetermined lay and over the conductor the usual rubber insulation is applied.

✦ ✦ ✦

No. 2,118,630, ELECTRIC CABLE, Patented May 24, 1938 by Richard C. Waldron, Clifton, N. J., assignor to The Okonite Company, Passaic, N. J., a corporation of N. J.

The lay of the conductor is made sufficiently long so that the cable cannot be stretched without the conductors pulling down on the core and being deformed, thereby adding the full strength of the conductor to the core.

✦ ✦ ✦

No. 2.118,758, PROCESS OF MAKING ZINC-COATED FERROUS WIRE, Patented May 24, 1938 by Frederick M. Crapo, Muncie, Indiana, assignor to Indiana Steel & Wire Company, Muncie, Ind., a corporation of Indiana.

The wire is treated at elevated temperature in a salt bath to produce on the surface of the wire a permeative addition of material of the class consisting of carbon and nitrogen and phosphorous, then the wire is quenched, coated by hot-dipping in zinc, and the temper is then partially drawn by subsequent heat treatment.

✦ ✦ ✦

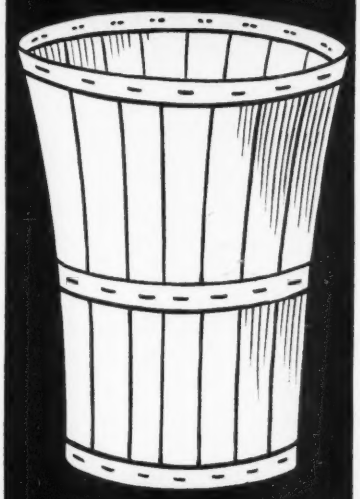
No. 2,119,002, SPRING COILING MACHINE, Patented May 31, 1938 by Charles R. Bergevin, Worcester, Mass., and Arthur C. Nigro, Torrington, Conn., assignors to The Torrington Manufacturing Company, Torrington, Conn., a corporation of Connecticut.

Cooperating feed rolls are mounted on shafts supported by spaced frame members and are rotated intermittently by

(Please turn to Page 372)

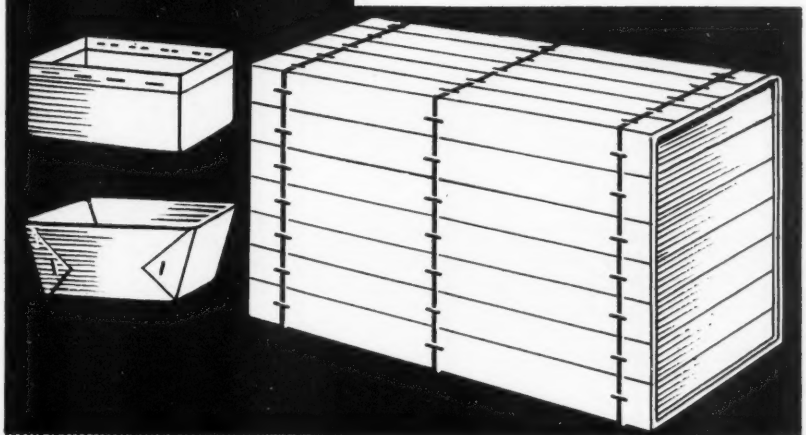
Wire

BINDING STAPLING



For ease of working and security of fastening Continental offers a correct combination of analysis and temper to suit every binding and stapling job. Appearance of the product is enhanced by a choice of widely varied finishes, many of which afford different degrees of rust resistance. Among them are bright, bright and black annealed, galvanized, liquored, coppered, and tinned. Produced by most modern equipment and methods, this quality wire is backed up by prompt, dependable service. Consult our metallurgists on these or any other applications of manufacturers wire.

CONTINENTAL STEEL CORP.
General Offices: Kokomo, Indiana
Plants at Canton, Kokomo, Indianapolis



CONTINENTAL

STEEL SHEETS AND WIRE PRODUCTS

Wire: Bright Basic, Annealed, *Konik, Special Manufacturers, Galvanized, *Flame-Sealed

Wire Rods, Nails, Staples, Bale Ties, Barbed Wire: Fence — 15 Types; Gates and Fittings

Sheets: Black, Galvanized, Special Coated; Roofing and Siding—14 Styles

*Trade Mark Registered, U. S. Patent Office

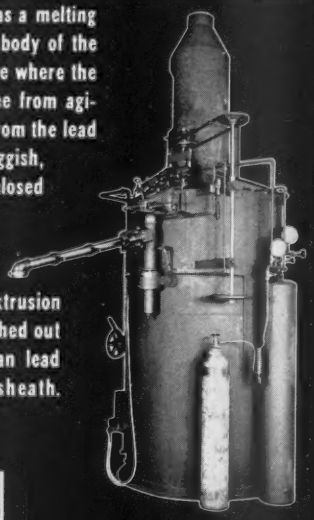
OPEN NEW MARKETS

WITH THE MONEY IT SAVES!

In the Robertson Closed Lead Melting Pot, CO_2 gas is used to keep down the formation of oxides over the lead in the melting pot and also during the process of filling the extrusion cylinder with lead.

The large valve opening with free flow helps to quickly fill the extrusion cylinder; the valve is entirely outside of the melting pot so that it may be easily cleaned and serviced.

The filling tube serves as a melting chamber and the main body of the pot serves as the storage where the molten lead is quite free from agitation. Oxides and dirt from the lead pigs, which may be sluggish, float to the top of the closed quiet storage space and are trapped. Only clean lead is drawn from storage to extrusion cylinder, previously flushed out with CO_2 gas . . Clean lead makes better cable sheath.



ROBERTSON LEAD MELTING POT CLOSED TYPE

JOHN ROBERTSON COMPANY, INC.

125-137 Water Street, Brooklyn, N. Y.

A Review of Recent Wire Patents

(Continued from Page 371)

drive means including a rotary element having a crank and pin connection for oscillating a segmental gear provided with a ratchet transmission and with variable gearing whereby to change the degree of rotation of the feed roll shafts for a given amplitude of oscillation of the segment.

✦ ✦ ✦

No. 2,119,366. METHOD OF AND APPARATUS FOR CONSTRUCTING SUSPENSION CABLES, Patented May 31, 1938 by Charles C. Sunderland, New Brunswick, N. J., assignor to John A. Roebling's Sons Company, Trenton, N. J., a corporation of New Jersey.

The method requires the arrangement of strands in vertical tiers which are separated up to the latest possible moment prior to compacting, so as to provide vertical draft channels through which a flow of air can take place and bring all the strands to the same temperature, and the compacting is done as rapidly as possible.

✦ ✦ ✦

No. 2,119,368, BEDSPRING, Patented May 31, 1938 by Don Carlos Travis, Kenosha, Wis., assignor to Simmons Company, New York, N. Y., a corporation of Delaware.

Disposed within a border frame is a plurality of axially vertical coil springs supporting a grill of strap material which is resiliently connected along its marginal edges to the border frame.

✦ ✦ ✦

No. 2,116,812, SEAM-WIRE AND METHOD FOR MAKING WIRE-CLOTH SEAMS, Patented May 10, 1938 by Nelson W. Webb, Belleville, N. J., assignor to Eastwood-Nealley Corporation, Belleville, N. J., a corporation of New Jersey.

For making wire-cloth seams, a wire having a cruciform transverse section is employed, formed of fusible material except for a longitudinal axial core of infusible material.

✦ ✦ ✦

No. 2,116,857, SCREEN FOR AUTOMOBILE RADIATORS, Patented May 10, 1938 by Ben Wengard, Waterloo, Iowa.

Formed of bendable rod wire is an endless open frame having a flexible cover, to which is stitched a bendable netting comprising evenly spaced cross warp and longitudinal reeds in varying arrangements.

✦ ✦ ✦

No. 2,117,217, DANDY ROLL AND CYLINDER MOLD AND METHOD OF MAKING SAME, Patented May 10, 1938 by Peter S. Sinclair, Holyoke, Mass.

The invention aims to provide a soldered seam for dandy rolls offering practically the same drainage area as other parts of the wire fabric where there is no seam, means being employed in the construction thereof to cause most of the solder to take its position near the ends of the abutting wires and in which a much smaller quantity of solder is permitted to take its position away from the ends of the wires.

No. 2,117,222, DANDY ROLL AND CYLINDER MOLD AND METHOD OF MAKING SAME, Patented May 10, 1938 by Peter S. Sinclair, Holyoke, Mass.

Between the opposed ends of the warp wires is disposed a seam connecting member comprising a middle reinforcing portion and two adjacent layers of fusible material on opposite sides of the middle portion. Clamps are employed to bring the edges together and a blow torch or other heat is applied to the joint so that as the laminations soften, the ends of the warp wires are drawn slightly closer together.

✦ ✦ ✦

No. 2,117,651, ROD CLEANING MACHINE, Patented May 17, 1938 by John J. Caugherty, Donora, Pa.

Scale and surface impurities are removed by drawing the rod over pluralities of vertically and horizontally disposed stationary sheaves arranged to bend the rod in vertical and horizontal directions, through a straightening die and between brushes which rotate at a speed determined by the speed at which the rod is drawn therethrough.

✦ ✦ ✦

No. 2,117,748, SPRING CUSHION STRUCTURE, Patented May 17, 1938 by Theodore D. Stewart, Detroit, Mich., assignor, to L. A. Young Spring and Wire Corporation, Detroit, Michigan.

The border frame is of S-shape in cross section to provide an upper inwardly facing channel in which is clamped portions of the end coils of the cushion springs, and a lower outwardly facing channel for the reception of the lower edge of the upholstery.

✦ ✦ ✦

No. 2,117,818, WIRE ROPE, Patented May 17, 1938 by Heinrich Oechslin, Romanshorn, Switzerland.

In wire rope strands, profile wires of sector or wedge shape in cross section are provided, on their contacting lateral boundary surfaces, with recesses which are so dimensioned that they leave a clearance space in the locking direction for the filling wire embraced by them or for a projection on one side of the profile wire. The invention also applies to hollow ropes consisting of one or more layers of profile wires.

✦ ✦ ✦

No. 2-117,959, CABLE WRAPPING MACHINE, Patented May 17, 1938 by Harry Clyde Hunter, Chicago, Ill., assignor to American Bridge Company, a corporation of New Jersey.

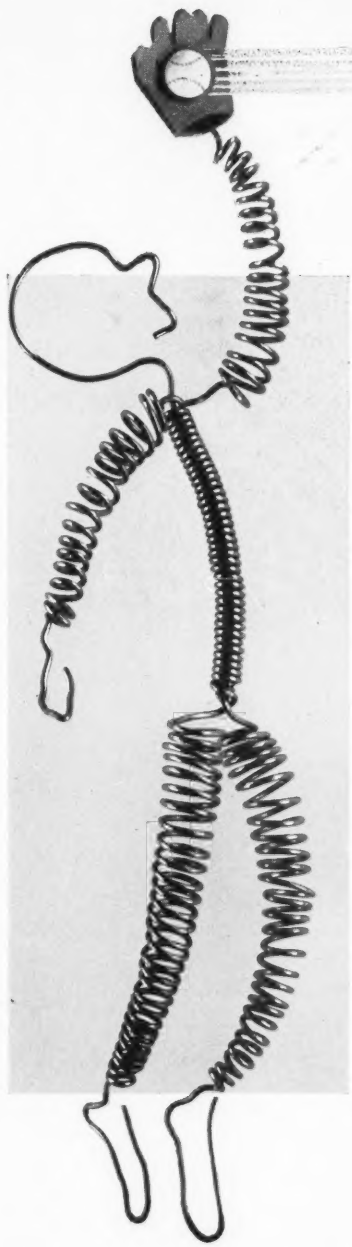
In connection with compacting machines which hold the cable until the restraining wire is applied, the wire is wrapped around the cable with a predetermined tension and each turn around the cable holds its share of the total restraining forces, the machine including an automatic level winding device for placing the wire evenly and uniformly around the cable.

✦ ✦ ✦

No. 2,118,005, ELECTRIC CABLE, Patented May 17, 1938 by Otto Cords, Berlin-Lichterfelde, Germany, assignor to Norddeutsche Kabelwerke A. G., Berlin-Neukolln, Germany.

It has been found that an effective form of concentric cable may be obtained by making the outer covering in the form of helical windings and passing threads which support the axial con-

(Please turn to Page 374)



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✦ ✦ ✦

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Wire & Wire Products

17 E. 42nd St., NEW YORK, N. Y.

A Review of Recent Wire Patents

(Continued from Page 373)

ductor between the convolutions of the windings. Preferably, three helical windings are provided, two of which are wound in the same direction.

✦ ✦ ✦

No. 2,118,008. OVERHEAD ELECTRIC TRANSMISSION LINE, Patented May 17, 1938 by Frederick M. Crapo, Muncie, Ind., assignor to Indiana Steel & Wire Company, Muncie, Ind., a corporation of Indiana.

High tensile strength plus high electrical conductivity is attained by forming the wire of cold-drawn carbon steel wherein the carbon content ranges from about 0.15% to 0.25% and wherein the manganese content is not in excess of the carbon content.

✦ ✦ ✦

Design No. 109.730, DESIGN FOR A SPRING, Patented May 17, 1938 by George G. Powers, Chicago, Illinois.

The design consists of a spring having a head portion comprising a plurality of turns of flat wire lying in a common plane, the flat wire of the top arranged so that its greater transverse dimension extends horizontally, and having a body portion of less diameter than the head, the body being composed of two series of coils of flat wire separated by a plurality of closely coiled turns of round wire located at the point of smallest diameter.

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✦ ✦ ✦

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✦ ✦ ✦

THE uniformity of Trenite is such that an analysis made by a large oil company in 1938, was almost identical with a previous analysis made on material furnished in 1932. This product seems to have found a place in the fields of temperature and abrasion which, considering its low cost, it seems destined to hold indefinitely.

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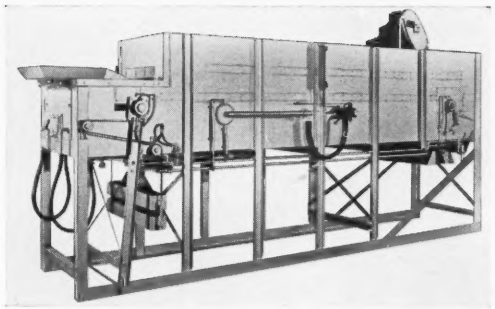
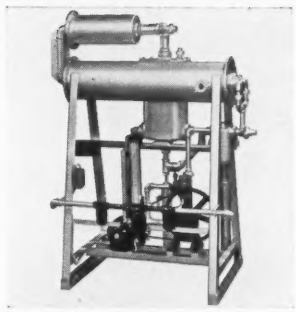


Scale-free Conveyor Hardening Furnace



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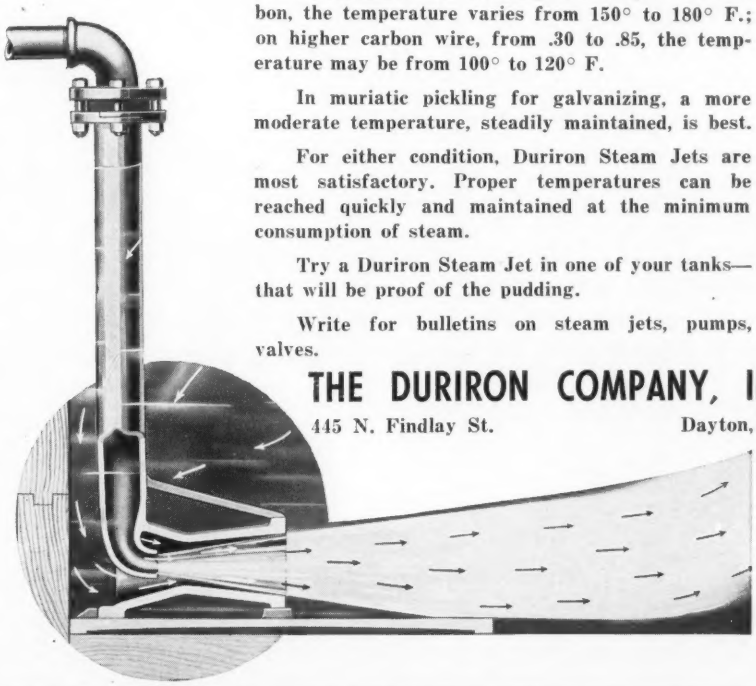

In sulphuric acid cleaning of rod up to .25 carbon, the temperature varies from 150° to 180° F.; on higher carbon wire, from .30 to .85, the temperature may be from 100° to 120° F.

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'Round the World With The Wire Industry

(*Continued from Page 368*)

German Steel Wire Prices Reported Stable

THE Association of **German** Steel Wire Manufacturers reports that since the beginning of 1938 domestic business in spring steel and rope wire has shown no noteworthy change, advises the American Consulate, Cologne. Prices have remained stationary; however, the price fixing commission is now engaged in a study of conditions. Export business has shown a strong downward tendency since the beginning of Jaunary, but export prices have generally remained unchanged.

✦ ✦ ✦

German Wire Rope Industry

GERMAN manufacturers of wire rope report that this year's spring business is satisfactory and that large orders have been received from the building trade, the forwarding business and the farming industry, advises the American Consulate, Cologne. German exports of wire rope in 1937 were a record level, but attention has been called to the fact that the foreign demand has been declining steadily for several months; also export prices have been following a downward trend.

✦ ✦ ✦

Cuban Wire Rope Imports

IN 1937, **Cuba** imported 424 metric tons of wire rope in comparison with 331 in the preceding year and 219 in 1935, according to information from the office of the American Commercial Attache, Habana. In all 3 years, the United States was the leading supplier, followed by Germany and the United Kingdom. The most important demand for wire rope in Cuba is said to have come from 1938 domestic business in spring made to some industrial organizations, and to the telephone and electric power companies.

The 1938 Meeting of The Wire Association will be held at Detroit, Mich., October 17-22, 1938.

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✦ ✦ ✦

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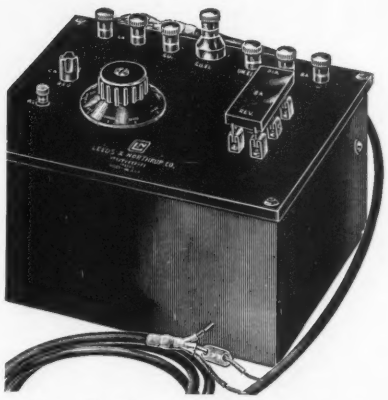

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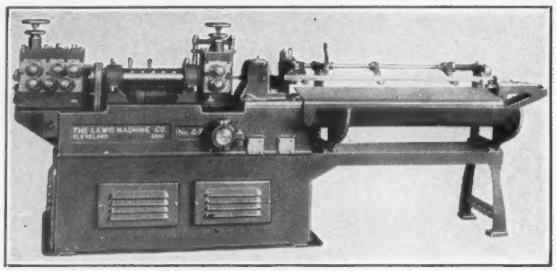

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The Manufacture of Spring Wire From Low Carbon Steel

(*Continued from Page 358*)

carbon and .56 manganese gave 123,000 with 4% elongation and showed true martensite. Steel of .13 carbon and .88 manganese hardened at 800° C. had a tensile of 124,000 with 4% elongation. When higher amounts of carbon and manganese are in question the observations of the students mentioned above are pertinent; but with lower carbon the influence of quenching rate overshadows that of chemical composition.

✦ ✦ ✦

FIG. 7 shows the influence of segregation, and is the result of researches on basic open-hearth and basic converter steel rolled into rods. Bundles were selected to represent various regular steps along the ingot from top to bottom, so that all stages of segregation were present. An effort was made to grade the purity on a numerical basis, calling the purest number 1. This rating was found to express the hardness of the stock, and also its increase in hardness due to quenching. The tests made by **F. Wüst** and **H. L. Felser (21)** lead to the same conclusion. The smallest increases in tensile due to quenching almost always correspond to the spots of greatest purity. The conclusion easily reached is that inclusions promote the germination of crystals and a refining of the grain. (17, 22, 23).

✦ ✦ ✦

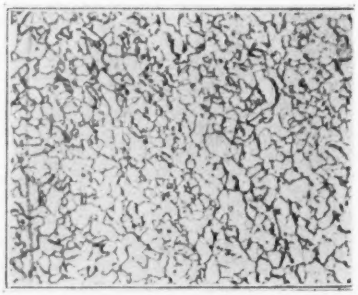

Fig. 14a. Quenched low carbon rod, 6 mm., from the mill test. ✦ ✦ ✦

PERHAPS the quenching from high temperature also has an influence on the speed of germination and of crystallization. This would seem to be indicated by the frequent extreme fineness of grain in water-hardened low carbon steel.

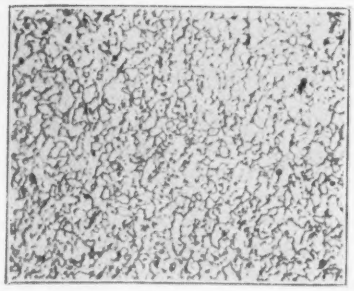

Fig. 14b. Quenched low carbon rod, 6 mm., with .072 Sal.

✦ ✦ ✦ ✦

(see Fig. 14, a and b). The researches so far published were practically all carried out on steels high in phosphorus and sulphur. Oxygen also, in solid solution, might contribute to refining the grain. It is credited with having raised the tensile of a .035 carbon .25 manganese steel to 92,000 lbs.

Part II will be published in August

✦ ✦ ✦

Novel Gas Furnace Improves Bright Annealing

(*Continued from Page 361*)

diameter and 43 in. deep, inside dimensions. Outside it is 57 in. in diameter and 53 in. high and enslosed in a steel case. The cover is raised and lowered by block and tackle and has an asbestos seal to keep cold air out when the furnace is operating. Heat is supplied by 11 gas burners evenly disposed about the wall of the furnace. They fire into a 3 or 4 in. combustion space but do not impinge on the heating chamber wall.

✦ ✦ ✦

THE same combustion system is employed on the furnace as has already been described. Only one inspirator and zero gas governor are used and a single solenoid valve in the air line. However, two thermocouples are employed, one in the combustion chamber and one in the heating chamber. The thermocouple in the combustion chamber is connected to a potentiometer while that in the heating chamber is connected to a pyrometer controller. Up to a certain temperature the potentiometer is in control, but when past this temperature the control is automatically shifted to the pyrometer.

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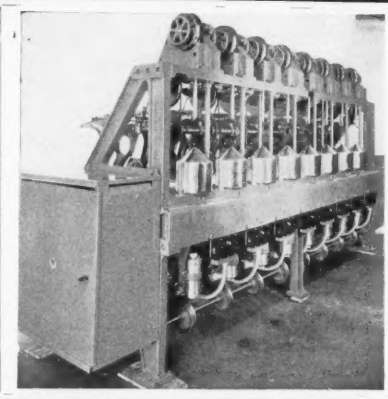

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Germany

Protection of Steel Against Rust In Storage

THE rusting of steel in storage is a problem that has been successfully solved by the use of gas unit heaters. On the docks at the Port of Vancouver, Washington, are two large storage rooms used for warehousing canned goods en route to foreign countries. Troubled with rust spots formed on the cans, gas unit heaters were suspended from the ceiling at several points. Heated air, blown throughout the rooms from these heaters, completely eliminated this adverse condition.

✦ ✦ ✦

ONE of the world's largest steel companies also had difficulty with rust spots forming on steel stock in storage. This too was corrected by the installation of gas unit heaters in the warehouses of this company both in Portland, Oregon and Seattle, Wash. These gas unit heaters are small, self-contained units that provide positive circulation of heated air. They take the place of the central heating plant, and are entirely automatic in operation. They require no attention whatever. Both the Seattle Gas Co. and the Portland Gas and Coke Co. cooperated in the installation of these gas unit heaters.

✦ ✦ ✦

FROM New York City comes a similar story. A dealer in tool steel (bar and block) stores something more than 5 car-loads in an unheated warehouse. During working hours the doors are open. In cold weather, naturally, the steel becomes cold. If the weather turns warm, it means, here—near the water front—that the warm air carries more moisture than the colder air in the warehouse, and the cold steel acts like a condenser. This condition is especially bad when weather turns warm during the night. The Consolidated Edison Co. of New York, Inc., installed two gas unit heaters and the practice now is to turn on the gas unit heaters, when the weather turns warm, keeping the doors shut for a few hours. The result: room is warm enough to keep steel dry, thus preventing rust spots — It works.

STEEL **STEVENS** REELS
FOR
WIRE AND CABLE INDUSTRY
STEVENS METAL PRODUCTS CO.
NILES, OHIO.

✦ ✦ ✦

Exports and Imports

(*Continued from Page 365*)

valued at $222; Netherlands West Indies 200 gross valued at $124.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 8,397 gross valued at $409. Of this total Japan supplied 8,220 gross valued at $338 and the United Kingdom 177 gross valued at $71.

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Heat Exchangers for Corrosive Liquids

AN illustrated 8-page bulletin has been issued by The Duriron Company of Dayton, Ohio, on the construction and use of two different size heat exchangers for corrosive liquids, such as pickling and plating solutions. Capacity curves and formula for figuring the heat requirements of plating tanks are also given.

✦ ✦ ✦

A NEW portable heating and filter unit is illustrated and described. This unit was first shown publicly at the American Electroplaters' Convention in Milwaukee in June, where it attracted much favorable interest.

✦ ✦ ✦

FREE copies of this bulletin are available to readers of this publication upon request.

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ABRASIVES—
Norton Co., Worcester, Mass.

ALLOY CASTINGS—
Trenite Corp., Trenton, N. J.

ANNEALING POTS AND BOXES—
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

ANTI-RUST—
Magnus Chemical Co., Garwood, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt, Co., Providence, R. I.
Sleeper & Hartley, Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS—Rod and Wire
Morgan Construction Co., Worcester, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CEMENT FLOOR CLEANER—
Magnus Chemical Co., Garwood, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.

CLEANERS—Hand and Metal
Magnus Chemical Co., Garwood, N. J.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

CONDUITS—Iron and Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONTROLS—Automatic
Leeds & Northrup Co., Philadelphia, Pa.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Cochaud Wire Die Co., New York, N. Y.
Driver-Harris Co., Harrison, N. J.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Rod and Tube Drawing
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Carboloy Co., Inc., Detroit, Mich.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES—
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

ENGINEERS—Consulting Wire Mill
Lewis, Kenneth B., New York, N. Y.
Hartley, George D., Worcester, Mass.

WHERE TO BUY, Continued

EQUIPMENT—Insulation Testing
Leeds & Northrup Co., Philadelphia, Pa.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FURNACE CASTINGS—Heat Resisting
Trenite Corp., Trenton, N. J.

FURNACE CONTROLS — Combustion
Leeds & Northrup Co., Philadelphia, Pa.

FURNACE CONTROLS—Draft
Leeds & Northrup Co., Philadelphia. Pa.

FURNACES—Annealing
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia. Pa.
Surface Combustion Corp., Toledo, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia. Pa.
Surface Combustion Corp., Toledo, O.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Hayes, C. I., Inc., Providence, R. I.
Surface Combustion Corp., Toledo, O.

FURNACES—Electric
Electric Furnace Co., Salem, O.
Hayes, C. I., Inc., Providence, R. I.
Surface Combustion Corp., Toledo, O.

FURNACES—Hardening and Tempering
Electric Furnace Co., Salem, O.
Hayes, C. I., Inc., Providence, R. I.
Leeds & Northrup Co., Philadelphia. Pa.
Surface Combustion Corp., Toledo, O.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, O.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, O.

FURNACES—Normalizing
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia. Pa.
Surface Combustion Corp., Toledo, O.

FURNACES—Wire, Strip & Sheet
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, O.

GALVANIZERS' BLANKET—
Gray Chemical Co., Roulette, Pa.

GRINDERS—Roll
Norton Co., Worcester, Mass.

INHIBITORS
American Chemical Paint Co., Ambler, Pa.

INSTRUMENTS—Electrical
Leeds & Northrup Co., Philadelphia, Pa.

INSULATION — Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.

LUBRICANTS—Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
Amer. Insulating Mach'y Co., Phila., Pa.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt, Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
Amer. Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt, Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Coilers
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange, New York, N. Y.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Enameling
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
Amer. Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt, Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
Amer. Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY — Measuring Wire & Cable
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Rubber Strip Covering
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—For Shaping and Embossing Wire
Standard Machinery Co., Auburn, R. I.

MACHINERY—Special
Amer. Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

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W. A. Schuyler, New York, N. Y.

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Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange, New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Taping
Amer. Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Size of Wire
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Fall, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
Amer. Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Youngstown, O.
Amer. Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Wire Rope
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

PANS—Lead Melting
Trenite Corp., Trenton, N. J.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

PIPING AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

PYROMETERS—
Leeds & Northrup Co., Philadelphia, Pa.

RECORDERS—
Leeds & Northrup Co., Philadelphia, Pa.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS AND SPOOLS—Shipping and Shop
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.

TESTERS—For Stiffness of Wire
Tube Parts and Machinery Div., RCA Manufacturing Co., Harrison, N. J.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Fall, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

TURKS HEAD—
Standard Machinery Co., Auburn, R. I.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
Amer. Insulating Mach'y Co., Phila., Pa.

WELDERS—Spot and Butt
Micro Products Co., Chicago, Ill.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

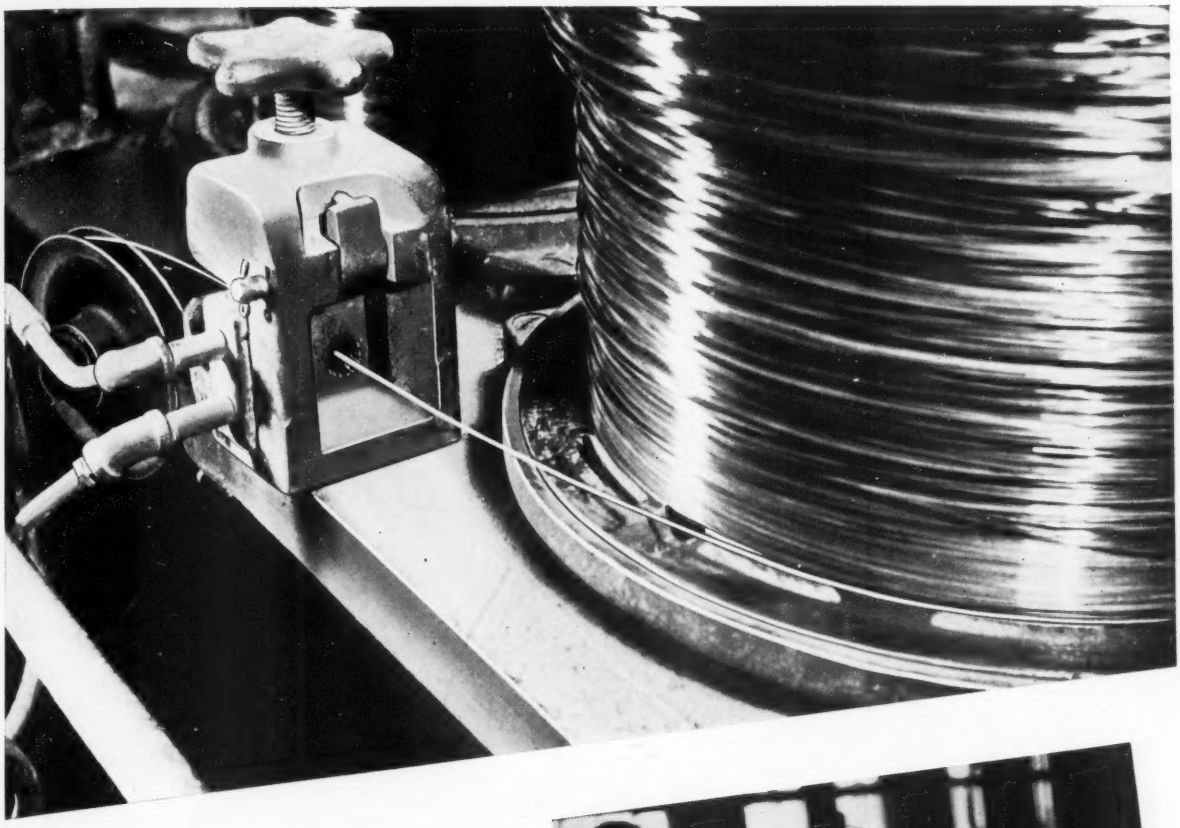
WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.

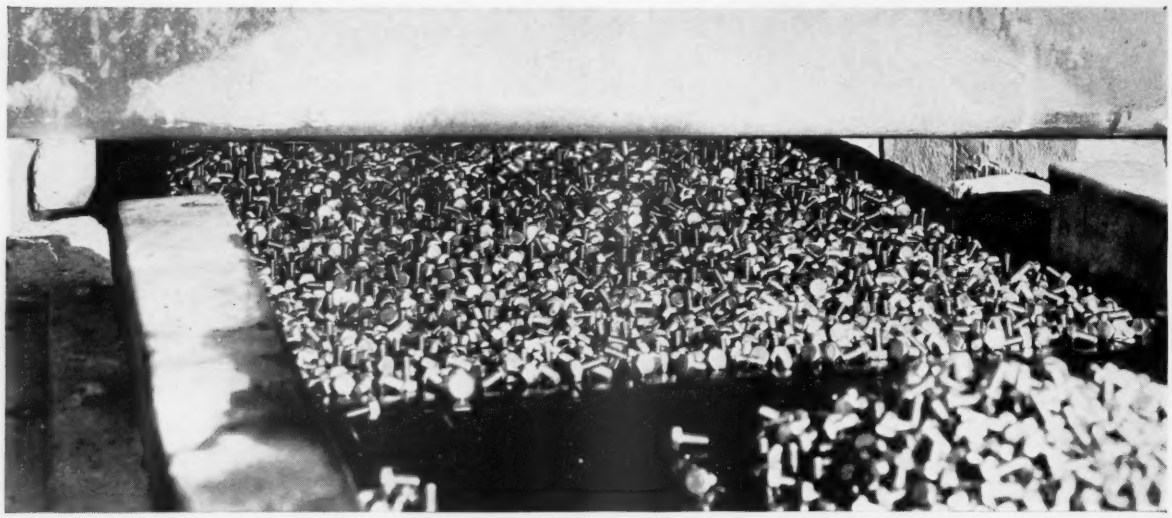


Unusual flexibility is afforded by Morgan-Connor Wire Machines, made in 3, 4, 5, 6, 7 and 8-block types with block diameters of 22, 16, 12 or 8 inches. Both high carbon and low carbon stock may be drawn at high speed by means of the exclusive storage principle and air cooling system. Morgan Construction Co., Worcester, Mass., U. S. A.

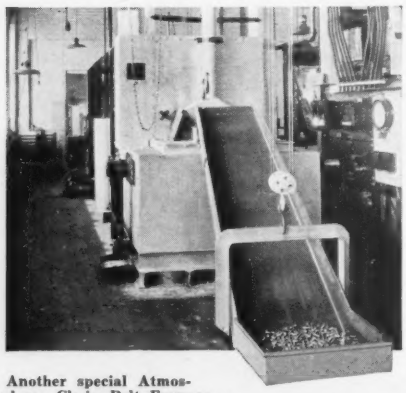
MORGAN-CONNOR

Continuous Wire Drawing Machinery

Sole European Representatives—Malmedie & Co., Dusseldorf, Germany



Controlled Atmosphere, Continuous Chain Belt Conveyor Furnace, Scale-Free Hardening Bolts



Another special Atmosphere, Chain Belt Furnace, with Feed Chute, for Clean Hardening Bolts

Investigate the Advantages of these Continuous, Chain Belt Conveyor Type Special Atmosphere Furnaces

The above illustration shows the interior of one of our standard, continuous chain belt conveyor furnaces. These furnaces are built for operating with special protective atmospheres for scalefree heat treating and clean and bright hardening. Several installations thus equipped are shown at left and below.

The material is loaded directly onto a rugged, cast link, heat-resisting alloy belt conveyor . . . carried thru the furnace in an inexpensive protective atmosphere and discharged absolutely free from scale . . . no pans or trays are used . . . 100% net material.

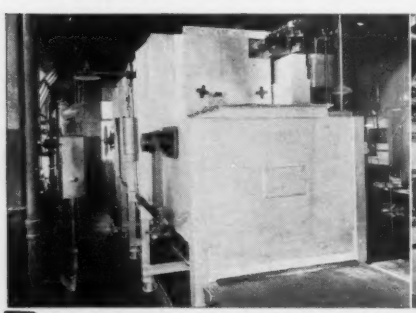
The special protective atmosphere is provided by an Elfurno generator furnished with the furnace.

Time and temperature are automatically controlled as well as the atmosphere . . . insuring accurate, uniform, scale-free results.

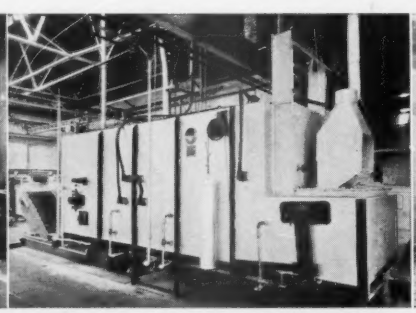
These furnaces are built in five standard sizes with capacities ranging from 300 to 1700 pounds per hour. Larger and smaller sizes can also be furnished.

The Electric Furnace Co., Salem, Ohio

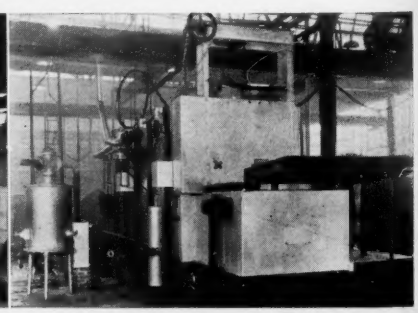
Designers and Builders of Electric, Oil and Gas Fired Furnaces for every Industrial Heating Process.



400 lbs. of Miscellaneous Parts, per hour, are Clean Hardened in this Continuous Furnace



An 800-lb. Capacity Furnace Clean Hardening Miscellaneous Screw Machine Products



A 1000-lb. Capacity Clean Hardening Furnace —Other Sizes Available for 300 to 1700 lbs. per hour.